BULLETIN 460 JUNE, 1948

COMMONWEALTH INST.
ENTOMOLOGY LIBRARY
- 1 NOV 1948
SERIAL
SEPARATE U.S.A.3

SCIENCE SERVES MAINE AGRICULTURE

Sixty-Fourth Annual Report of Progress
Year Ending June 30, 1948

Fred Griffee, Director
The Maine Agricultural Experiment Station
University of Maine

Orono, Maine

Aroostook Farm, Presque Isle, Maine, where much of the potato research work is conducted

UNIVERSITY OF MAINE

MAINE AGRICULTURAL EXPERIMENT STATION

UNIVERSITY AGRICULTURAL ADVISORY COUNCIL

Arthur A. Hauck, President of University.....Chairman
Arthur L. Deering, Dean of Agriculture.....Secretary
Frank W. Hussey, Presque Isle.....University Board of Trustees
Albert K. Gardner, Augusta.....Commissioner of Agriculture

Wilson M. Morse, Waterford
Seavey A. Piper, Troy
Harold J. Shaw, Sanford
Mrs. Marjorie E. Wilder, Norridgewock
A. Russell Mace, Aurora
Clarence W. Parker, Sebec
Norris Clements, Winterport
Albert L. Robinson, Houlton
Mrs. Dorothy M. Payson, Falmouth Foreside
Milton E. Smith, Presque Isle

EXPERIMENT STATION STAFF

ADMINISTRATION

A. L. Deering[3].....Dean
Fred Griffee.....Dir.
G. F. Dow[3].....Asst. Dir.
Yvonne Morin[3].....Sec. to Dean
Mary N. Cameron.....Sec. to Dir.

AGRICULTURAL ECONOMICS

C. H. Merchant[3].....(Head) Agr. Econ.
G. F. Dow[3].....Agr. Econ.
H. A. Luke[1,3].....Assoc. Econ.
W. E. Schrumpf.....Asst. Econ.
A. E. Watson.....Asst. Econ.
H. C. Woodward[1].....Asst. Econ.

AGRONOMY

W. C. Libby[3].....(Head) Agron.
H. D. Bartlett.....Asst. in Agr. Eng.
P. N. Carpenter.....Asst. Agron.
P. J. Eastman[2].....Asst. in Agron.
S. C. Junkins.....Asst. in Agron.
C. H. Moran[3].....Assoc. Agron.
A. E. Prince[3].....Asst. Pl. Phys.
R. A. Struchtemeyer[3].....Asst. Agron.
G. L. Terman[3].....Agron.
M. F. Trevett[3].....Asst. Agron.
J. P. Wescott[1,2].....Asst. in Agron.

ANIMAL HUSBANDRY

A. O. Shaw[2,3].....(Head) An. Husb.
H. C. Dickey[1,3].....(Head) An. Husb.
L. M. Dorsey[3].....Assoc. Dy. Husb.
H. W. Hall[3].....Asst. An. Husb.
J. F. Witter[3].....Assoc. An. Path.

CHEMISTRY

E. R. Tobey.....(Head) Chem.
A. S. Getchell.....Asst. in Chem.
J. S. Getchell.....Assoc. Bact.
M. E. Highlands[1].....Assoc. Food Tech.
F. Hyland[3].....Seed Analyst
E. O. Merrill.....Asst. in Chem.
M. G. Moore.....Asst. Chem.
B. E. Plummer, Jr.....Chem.
G. A. Waddell.....Tech.
C. H. White.....Assoc. Chem.

ENTOMOLOGY

F. H. Lathrop.....(Head) Ent.
R. M. Cobb.....Asst. in Ent.
C. O. Dirks[3].....Assoc. Ent.
J. H. Hawkins.....Assoc. Ent.
E. M. Patch.....Emeritus, Ent.
W. F. Porter.....Collab. Ent.
G. W. Simpson.....Assoc. Ent.

FORESTRY

R. I. Ashman[3].....(Head) For.
Gregory Baker[3].....Assoc. For.
F. K. Beyer[1,3].....Asst. For.

HOME ECONOMICS

Pearl S. Greene[3].....(Head) Home Econ.
Mary M. Clayton.....Nutr.
Merna M. Monroe.....Asst. Home Econ.
Dorothy E. Ullman[1].....Asst. in Nutr.

HORTICULTURE

C. W. Hitz[2,3].....(Head) Assoc. Hort.
R. M. Bailey.....Assoc. Genet.
Elizabeth F. Murphy.....Asst. Biol.
A. A. Virta[2,3].....Asst. in Hort.

PLANT PATHOLOGY

Donald Folsom.....(Head) Pl. Path.
Reiner Bonde.....Pl. Path.
M. T. Hilborn.....Assoc. Pl. Path.

POULTRY HUSBANDRY

J. R. Smyth[3].....(Head) Py. Husb.
T. G. Culton[2,3].....Asst. Py. Husb.
E. C. Howes[3].....Asst. in Py. Husb.

FARM SUPERINTENDENTS

S. O. Hanson.....Aroostook Farm
F. J. McDonald.....Highmoor Farm
G. W. Wilson.....Blueberry Farm

[1] Appointment effective after July 1, 1947.
[2] Resignation effective prior to June 30, 1948.
[3] Station work on part time basis.

P.A.B
7 DEC 1948

CONTENTS

	PAGE
COMMENTS BY THE DIRECTOR	1
APPLES	4
Apple Tree Winter Injury	4
Breeding New Apple Varieties for Maine	4
Spray Materials for Apples	4
Spray Deposits on Apple Foliage	5
Spray Booms	5
Apple Fertilization	5
Apple Insects	6
Maintaining Quality and Reducing Losses During Each Step in Marketing Maine Apples and Apple Products	7
Improvement of Preprocessing and Freezing Methods for McIntosh Apples	9
BEANS	9
Field Bean Variety Trials	9
Control of the Mexican Bean Beetle	9
Bean Weevil	10
BEEF CATTLE	10
Pastures for Beef Cattle	10
BLUEBERRIES	10
Blueberry Fruit Fly	10
Blueberry Thrips	11
Blueberry Disease Control	11
Blueberry Weed Control	11
Fertilizer Experiments with Blueberries	12
Blueberry Soil Investigations	14
A New Tool for Transplanting Blueberries	14
Increasing Plant Stand in Blueberry Fields	14
Rooting of Blueberry Cuttings	15
Artificial Pollination of Blueberry Flowers	16
Oil Burners for Blueberry Land	16
CORN	18
Sweet Corn Breeding and Variety Trials	18
European Corn Borer	18
Control of Weeds in Corn by Chemical Herbicides	19
Field Corn Investigations	21

CUCUMBERS 22
Breeding Scab Resistant Cucumbers 22
DAIRY 22
Costs of Producing and Distributing Milk 22
Milk Pricing 23
Seasonal Variation of Milk Production 23
Consumption of Dairy Products 24
Reducing Loss of Butterfat Tests in Composite Milk Samples 24
Dairy Farm Cheese 25
Calfhood Vaccination to Control Bang's Disease 25
Control of Mastitis 25
Possible Mineral Imbalance in Dairy Cattle 26
Inheritance in Dairy Cattle 26
Use of Four Per Cent Fat Corrected Milk Pedigree in Selecting the Dairy Herd Sire 26
Efficiency in Harvesting Hay 26
Artificial Hay Drying 27
Influence of the Feed Fed Dairy Cows on Rumen Digestion of Crude Fiber and the Synthesis of Thiamin and Riboflavin 27
FORESTRY 28
Board Foot-Cord Ratio Tables 28
Increased Production of Northern White Pine 28
Management of Small Woodland Areas in Maine 29
Artificial Pruning 29
Red Pine Sawfly 29
Service Life of Maine Woods for Posts 29
Seasoning of Maine Woods 29
Prevention of Stain and Decay in Birch Turning Bolts 30
Bronze Birch Borer 30
Spruce Budworm 31
GRAIN 32
Small Grain Trials 32
HOGS 32
Swine Feeding 32
Swine Breeding 32
HOME ECONOMICS 33
Comparison of Different Models and Sizes of Kitchen Sinks 33
Survey of Farm-Home Needs and Preferences for Working and Storage Spaces 34
The Nutritional Status of Junior High School Pupils in the City of Bangor 34

LETTUCE 34
Control of Yellows Disease of Lettuce 34
PEAS 35
Liming, Fertilizer and Seeding Rate Experiments on Peas for Processing 35
POTATOES 36
Potato Top Killing 36
Use of Insecticides to Control Aphids 37
Some Reasons Why Leafroll Did Not Spread Extensively in 1947 38
Florida Test 1947-1948 40
Dissemination of Potato Virus Diseases 40
Spray and Dusting Experiments to Control Potato Blight .. 41
Disinfectants for Control of Ring Rot 44
Purple Top and Its Control 45
Mild Seed Treatment for Control of Seed-Piece Decay 45
Development of New Potato Varieties 45
Development of Disease-Free Seed Potatoes and Effect on Yields 47
Potato Tuber Diseases in Storage and Transit 47
Potato Variety Testing 47
Potash Source Experiments 48
Radioactive Phosphorus Fertilizer Tests 49
Phosphorus Placement Tests 49
Liming and Rate of Phosphorus Tests 50
Nitrogen Rate Experiments 50
Response of Potatoes to Zinc 51
Potato Soil Fertility Experiments in Central Maine 51
Applying Mulch for Potatoes 52
Irrigation of Potatoes 53
Greensprouting and Thiourea Treatment 53
Chemical Weed Control in Oats, Peas, and Japanese Millet in the Potato Rotation 53
Soil Conservation and Development of New Equipment ... 54
New Experimental Potato Storage House 54
Recovery of Starch Plant Potato Pomace 54
Potato Harvesting Methods in Maine 55
Storage, Storing, Grading, and Packaging Maine Potatoes 55
Wholesale and Retail Distribution of Maine Potatoes 56
Potato Marketing Problems Resulting from War 58
POULTRY 59
Effect of Different Feeding Methods with Pullets on Ladino Clover Range 59

Breeding Barred Plymouth Rocks for Superior Meat Quality 59
Length of Incubation Period in Poultry as Related to Characteristics of Progenies 59
Natural and Synthetic Supplementation of Corn and Soybean Oil Meal Breeder Diets 60
A Study of Market Egg Production in Maine 61
Marketing of Hatching Eggs 61
PRICES 62
Agricultural Adjustments in Maine and Maine Farm Prices in Postwar Period 62
SHEEP 63
Early Versus Late Lambing 63
SOIL TESTING 63
Soil Testing Laboratory 63
STRAWBERRIES 64
Strawberry Variety Trials 64
TOMATOES 64
Control of Late Blight of Tomatoes 64
Tomato Variety Tests 64
INSPECTION SERVICE 66
WEATHER 69
PUBLICATIONS 70
FINANCIAL REPORT 73

COMMENTS BY THE DIRECTOR

Research Personnel. The value of the research program of the Experiment Station to Maine agriculture depends to a large extent upon the personnel conducting the research. The Maine Station has been fortunate in having a number of outstanding research authorities and has continued to conduct an increasingly effective program of investigation.

There continues to be a shortage of trained research workers throughout the United States. The result is severe competition for personnel from other Universities, government agencies and industry. The University of Maine has been able to grant some increase in salaries to help compensate for higher living costs; and has extended additional benefits in the retirement income plan.

A total of 7 new appointments were made to the research staff of the Station during the year. Resignations became effective for 6 staff members. These changes are indicated in the list of the Station Staff on the first page, see footnotes 1 and 2. Dr. Howard C. Dickey replaced Dr. A. O. Shaw as Head of the Department of Animal Husbandry. Dr. Chester W. Hitz resigned as Head of the Department of Horticulture, effective May 1, 1948. Prof. Pearl S. Greene retired June 30, 1948, as Head of the Department of Home Economics, but in recognition of her services will continue as an Emeritus member of the Staff. Dr. Louise A. Stedman has been promoted to Head of the Department. Matthew E. Highlands, after working in industry and serving during the war as Captain in the Quartermaster Corps, has returned to the University as Associate Food Technologist to fill a long recognized need in the research program.

Advisory Committees. The Experiment Station is indebted to a number of agricultural leaders in Maine for their cooperation and suggestions in the research program. Newly appointed members of the University Agricultural Advisory Council, serving agricultural teaching, extension and research, are Norris Clements of Winterport and A. L. Robinson of Houlton.

Appreciation also is acknowledged for the assistance of various commodity committees, including the Potato Tax Committee, of which Herbert Kitchen is chairman; and the Blueberry Industry Advisory Committee, of which A. Russell Mace is chairman.

State Advisory Marketing Committees also have been active

during the past two years assisting in coordinating the marketing work of the Experiment Station, Extension Service and State Department of Agriculture. These committees have helped in developing cooperative work with other States and the U. S. Dept. of Agriculture under the Research and Marketing Act of 1946. Mr. Clifford McIntire, Presque Isle, has served as Chairman of the Potato Marketing Committee, Norris Clements of Winterport and Chester Strout of Dexter have been Chairmen of the Poultry Marketing Committee, Mr. Clarence Parker of Sebec has chairmaned the Dairy Marketing Committee, and William Ricker of Turner has been Chairman of the Apple Marketing Committee.

The Experiment Station also welcomes the suggestions of any individuals or organizations as to how its program may more fully serve Maine agriculture in so far as personnel and funds permit.

EXPERIMENTAL FARMS. The Station conducts its research program on a number of farms in order to serve Maine's diversified agriculture. The Station operates Aroostook Farm at Presque Isle with 164 acres of cropland, Highmoor Farm at Monmouth with 255 acres of land, Blueberry Hill Farm in Jonesboro with about 32 acres of blueberry land, and an experimental poultry plant at Orono. Much of the research on hay drying, grassland experiments, and dairy feeding which formerly was done at Highmoor Farm has been transferred to the college farms at or near Orono. The Station also cooperates with the Maine Department of Agriculture in conducting work on the seed farm of the Maine Potato Seed Board in Masardis, and in the winter testing of 85 acres of seed potatoes grown in Florida. Much of the forestry research is conducted in the University Forest consisting of about 1700 acres near Orono. The Station also owns the Chapman Farm of 480 acres, with about 30 acres cleared, which is operated in cooperation with the U. S. Dept. of Agriculture for potato breeding work.

The Station also cooperates with a number of farmers, homemakers, and organizations in cooperative production and marketing studies in addition to the work on the regular experimental farms.

New developments during the year include the start of construction on an experimental potato storage house at Aroostook Farm for use in studies on methods of handling, grading, packaging and storing potatoes. A new Plant Science Building also is under construction at Orono which will materially relieve the crowded, un-

satisfactory laboratory and office conditions of the research, teaching and extension staffs.

FINANCIAL SUPPORT. The detailed financial statement is included on the last pages of this report. Special recognition however should be given to the new appropriations received under the Research and Marketing Act of 1946. These funds have made possible some expansion in the research program with special emphasis on marketing research. The Maine Station received during 1947-48 nearly $19,000 of direct appropriations and in addition was allocated cooperative regional funds of $7,875 for marketing and $10,600 for studies in human nutrition and in rural housing.

The Station wishes to express its appreciation for the cooperation received from a number of manufacturing concerns for supplying without charge special chemicals, equipment, and other products used in experimental work. Such assistance was a valuable supplement to the financial support received from various organizations.

RESEARCH PROJECTS. Many of the research projects included in this report have been aimed at increasing the efficiency of production and marketing. Such research is necessary if Maine agriculture is to survive and prosper in the more competitive post war era. The results of the research program have helped to achieve the increased agricultural production needed to meet our increase in population and the needs of foreign countries. The research program also recognizes the need for balanced production, and the most desirable use of the land in relation to demand and conservation of the soil. Work also is being undertaken by the Food Technologist in developing new and better products, thereby providing improved market outlets. The research work on vitamins, nutrition and rural housing is a guide to better health and living of Maine people.

The inspection service in cooperation with the Maine Department of Agriculture also renders special assistance to Maine agriculture in safeguarding the quality and maintaining the standards established for feed, fertilizer, seeds, spray materials, foods and drugs, and gasoline and motor oil.

The following pages of this bulletin include a summary of the many phases of research work conducted during the year ending June 30, 1948. A special reprint of the potato section is available to those who do not wish the entire report.

This summary has been compiled by Dr. George F. Dow, Assistant Director, from reports submitted by the research workers.

It is somewhat shorter than in preceding years due to the omission of most of the statistical tables and other technical details. More detailed results will be available in subsequent specialized bulletins when work on the various projects is sufficiently complete to warrant publication. Persons who have questions to raise or who desire more technical details are invited to correspond with the research worker whose name is listed with each project.

APPLES

APPLE TREE WINTER INJURY. M. T. Hilborn. Tayezhnoie, a Russian hardy stock that previously appeared promising, is incompatible with Rogers McIntosh, Delicious, and Spy, and is questionably compatible with Baldwin. Virginia Crab is questionably compatible with Rogers McIntosh, Spy, and Baldwin. Hibernal, however, continues to show excellent graft unions with practically all varieties. In view of these incompatibilities it would seem that Hibernal is the preferred stock at the present time for general orchard planting. Virginia Crab appears to form excellent trees when top-worked to Cortland and Delicious.

BREEDING NEW APPLE VARIETIES FOR MAINE. R. M. Bailey. The primary objective of this project is to produce better, late-keeping apple varieties. Approximately 1000 trees resulting from controlled crosses are rapidly coming into bearing. Many that have already borne fruit and found to be inferior have been removed from the orchard. A few selections have been found that merit more extensive trial. Some of the new named varieties received from other Stations that merit more extensive trial are Red Gravenstein, Milton, Macoun, and Linda.

SPRAY MATERIALS FOR APPLES. M. T. Hilborn. In 1947, which was again a "bad scab year," the fungicides being tried for scab control received a rather severe test. Of 12 different materials under test, Phygon, Puratized Agricultural Spray, a combination of Fermate and wettable sulphur, Puratized 806, and Bioquin I (copper 8-quinolinolate), equalled or surpassed the standard schedule of wettable sulphur, with Phygon and Puratized Agricultural Spray doing best. Phygon was used throughout the season while the Puratized was used only in the early sprays and was followed by wettable sulphur in the cover sprays. Glyoxalidine and Good-rite

(polyethylene polysulfide) were unsatisfactory. Fermate was ineffective in the early applications. Both Phygon and Puratized cause spray injury under some conditions and these materials need to be studied further before their widespread use in commercial orchards is justified. More details are included in Bulletin 457, "Recent Advances in Spray Practices for Maine Apple Orchards" by F. H. Lathrop and M. T. Hilborn. Jan. 1948.

SPRAY DEPOSITS ON APPLE FOLIAGE. F. H. Lathrop, M. T. Hilborn, B. E. Plummer, Jr., A. S. Getchell. Samples of apple leaves were collected at intervals from dusted plots and from sprayed plots during the summer of 1947. Chemical analyses were made to determine the deposits of arsenic and of sulphur on the sample leaves. In general, the data appear to confirm the results previously reported in Maine Agricultural Experiment Station Bulletin 449, pages 406-411, 1947 and Bulletin 457, pages 349-353, 1948.

SPRAY BOOMS. M. T. Hilborn, F. H. Lathrop. Details concerning the construction and operation of 2 homemade spray booms have been published as Bulletin 458, "Two Homemade Spray Booms for Maine Apple Orchards." Feb. 1948.

APPLE FERTILIZATION. C. W. Hitz, M. F. Trevett, R. M. Bailey. Yield records from the Demonstration Orchard at Highmoor Farm continue to show the importance of straw or hay mulches in orchard culture in Maine. Averages over a 5-year period show that the trees mulched annually with 200 pounds of hay or straw per tree have outyielded unmulched trees of otherwise the same treatment by as much as 40 per cent. None of the fertilizer treatments of N, NK or NPK applied at the rate of 60 pounds per acre for each element has produced a significant difference in yield.

Yield records from a young McIntosh orchard in Franklin County have revealed no significant differences in yield resulting from the fertilizer treatment of 2 levels of N, NK, NP, and NPK, with and without supplemental applications of magnesium. Trunk circumference and tree height measurements taken over the 3-year period of the experiment show that the proportional increase in size of trees receiving an annual application of 2½ pounds of magnesium sulphate per tree has been significantly higher than the trees receiving no magnesium. However, this difference in growth had not been great enough to cause a significant difference in tree size to exist in 1947. Data must be accumulated over a greater number of years before conclusive results can be expected.

From the harvests of 1946 and 1947, samples of fruits from the same orchard were selected at random and placed in storage. When the 1946 samples were examined in late March, the composite samples from the trees treated with magnesium averaged about 4 times as much bitter pit as samples from other trees. Bitter pit was not severe on any of the larger samples selected in 1947, but the trouble was slightly more prevalent upon samples from trees receiving the magnesium treatment. Other physiological breakdowns such as scald and soft scald, were not affected by the fertilizer treatment. More data need to be accumulated before conclusions can be drawn.

APPLE INSECTS. ***European Red Mite.*** F. H. Lathrop. This insect became increasingly destructive in many orchards during the summer of 1947. In spray tests, hexaethyl tetraphosphate, hexaethyl pyrophosphate, and parathion killed 90 per cent or more of the active stages of the mites. An important problem that remains is to time the applications so as to obtain maximum control through the season.

On the experimental plots of McIntosh apple trees treated with 3 applications of DDT dust following petal fall, for the control of oyster-shell scale, there was no greater build-up of mites than on the plots not treated with DDT.

Oyster-shell Scale. F. H. Lathrop. Dust applied in 1947 for the destruction of newly hatched oyster-shell scale crawlers confirmed the results of experiments conducted in 1946. Two or 3 thorough applications of 5 per cent DDT-sulphur dust destroyed a large percentage of the crawling scales and relieved heavily infested trees to such an extent that there was marked improvement in the general vigor of the trees. Two applications of liquid spray containing 3 pounds of 50 per cent DDT wettable powder in 100 gallons of water also were effective for controlling the scales. The applications of dust and of liquid spray were made at intervals of 5 to 7 days, beginning soon after petal fall. The timing of the applications was very important.

Apple Fruit Fly. F. H. Lathrop, B. E. Plummer, Jr., A. S. Getchell. During the summer of 1947, the experimental dust program for the control of fruit fly consisted of 2 applications of 75:25 sulphur-lead arsenate dust during the first half of July, followed by 2 applications of 5 per cent DDT in 85:15 sulphur-lead arsenate during the last half of July. The fruit was distinctly more free from fruit fly injury than had been produced in this orchard during the

preceding 3 years when 85:15 lead arsenate alone was used. Chemical analyses were made of a sample of the fruit from this orchard and also of fruit that had received 1 liquid spray application of DDT (3 pounds of 50 per cent DDT wettable powder in 100 gallons of water). The DDT residue at picking time did not exceed 0.61 part per million. According to present information this is well below any quantity known to be injurious to human health.

Green Apple Aphid. F. H. Lathrop. The new insecticides hexaethyl tetraphosphate, hexaethyl pyrophosphate, and parathion were found to be very effective for killing the aphids on apple trees. Reinfestation occurred, however, and it will be necessary to work out the most effective schedule for the control of the aphids.

Other Pests. F. H. Lathrop. The eastern tent caterpillar was so reduced in the spring of 1947 that it practically disappeared from Maine orchards. The white apple leaf hopper was especially abundant in a number of orchards. The potato leaf hopper also was more abundant and injurious to apple trees in Maine in 1947 than it had been for many years.

MAINTAINING QUALITY AND REDUCING LOSSES DURING EACH STEP IN MARKETING MAINE APPLES AND APPLE PRODUCTS. C. H. Merchant, H. C. Woodward. A study of the bruising of apples from orchards to retail stores was continued during the past year (Fig. 1). Much additional work was undertaken with lined and unlined boxes for handling apples in orchards and in storage. Results of previous years showed that the ordinary box caused a considerable amount of bruising in the handling of apples. It was found that the ordinary weight of McIntosh apples in a box caused sufficient pressure on the sides and the bottom of the box to bruise the fruit to the extent of leaving the imprint of the wood on some apples. Last fall apple boxes were lined with caps and in other cases apples were placed in layers in the boxes at the time of picking. This work was conducted in several orchards with the popular varieties of apples, giving special emphasis to McIntosh.

Some additional information was obtained on grading and packaging apples this year. Also, information has been obtained on the amount of bruising caused in transporting apples to retail stores in consumer packages and in bushel boxes.

Information was obtained from retail stores in Maine on the quality of fruit offered for sale. These data were collected during several periods in the marketing season to show variations in the

FIG. 1. Three Containers Used in Picking Maine Apples.
At the left is the picking bag, peach basket is in center, and metal picking bucket is on the right

quality of fruit offered for sale. The markets included were Portland, Auburn, Lewiston, Augusta, Bangor, and Dover-Foxcroft.

IMPROVEMENT OF PREPROCESSING AND FREEZING METHODS FOR McINTOSH APPLES. M. E. Highlands, C. W. Hitz. Work was started in October 1948 on improving the firmness of McIntosh apples for freezing. Various levels of calcium chloride as an additive have been tried as well as supplementing the pectin content. In addition various methods of preventing browning prior to freezing are being studied using ascorbic acid and sodium sulphite. Limited results do not warrant conclusions at this time. The work will be continued during the coming year.

BEANS

FIELD BEAN VARIETY TRIALS. R. M. Bailey. Thirty Yellow Eye type bean selections and 4 named varieties were compared in replicated yield trials at Highmoor Farm. The selections are the result of breeding for anthracnose resistance. Several selections compared favorably with Old Fashioned Yellow Eye in type and yield and were ready for harvest a week to 10 days earlier. Further trials are necessary, however, to determine if any are worthy of naming and release for general use. Yields in bushels per acre for the varieties were Lapin, 34; bush strain of Old Fashioned Yellow Eye, 28; semi-runner Old Fashioned Yellow Eye, 26; and ASL Pea bean, 25. Lapin has been outstanding in yield in several years trials at Highmoor and is a white marrow type bush variety that matures fully a week earlier than the semi-runner Old Fashioned Yellow Eye. It deserves more extensive trial in Maine. For those who desire to grow pea beans, the ASL Pea is suggested because it matures much earlier than such well known varieties as Robust and Emerson. The early maturity helps in escaping the discoloration so frequently encountered with late maturing varieties in Maine.

CONTROL OF THE MEXICAN BEAN BEETLE. J. H. Hawkins. The methoxy form of DDT did not prove effective against the Mexican bean beetle in preliminary experiments during 1947.

Recommendations made for Mexican bean beetles in Maine Agricultural Experiment Station Bulletin 431 are still valid. Formulae 1 and 3 on page 217 of this bulletin are especially recommended for use on beans before the pods are set on the bean plants. Dusts

containing magnesium lime, copper sulphate and calcium arsenate, recommended in Bulletin 431, will cause little or no injury to the bean plants. Early applications of insecticides to beans are economical and more effective than later applications when the beans are severely injured.

BEAN WEEVIL. F. H. Lathrop. A mixture of equal parts of black pepper and mustard appeared to be at least 4 times as effective as the same weight of either ingredient alone. The effectiveness of black pepper was considerably reduced after it had been kept at room temperature for a year or more. A significant correlation was found between the weight of a given volume of beans and the number of beans infested by weevils. Both the weights and number of infested beans may be used as an index of injury.

BEEF CATTLE

PASTURES FOR BEEF CATTLE. C. H. Moran, H. C. Dickey. On one 20-acre ladino clover pasture which was divided into 2 parts to enable the beef cattle to be rotated, 11 Aberdeen Angus heifers and steers grazed. This pasture was considered very good and was located in Aroostook County. The 11 head gained 2.54 pounds per head daily from June 11 to July 16. From July 16 to September 9 these cattle gained 1.95 pounds per head daily. During the 90 days the cattle gained 2.18 pounds per head daily. On an ordinary unimproved pasture located in Aroostook County 11 heifers gained 2.05 pounds daily per head from July 15 to September 10. In southern Maine, 18 steers and heifers were pastured on good ladino clover. These cattle gained 2.04 pounds per head daily from June 24 to July 25. These data show the amount of gains which can be obtained by grazing Maine pastures with beef cattle.

BLUEBERRIES

BLUEBERRY FRUIT FLY. F. H. Lathrop, F. B. Knight, B. E. Plummer, Jr., A. S. Getchell. During the summer of 1947, the flies began to emerge in the observation cages at Blueberry Hill Farm, Jonesboro, on July 10. The peak of emergence occurred about July 15 and practically all of the flies had emerged by July 30.

For the control of the fruit fly, applications were made of 6 different dust formulations. Tests were conducted on 5-acre plots. Comparisons were made of calcium arsenate alone, arsenic-copper-lime (50-10-40) mixture, and 5 per cent DDT. Both the calcium arsenate alone and the arsenic-copper-lime dust gave very satisfactory control, and decreased the infestation in the berries about 90 per cent. The DDT dust appeared to be somewhat less effective, with only about 70 per cent reduction of infestation. On the plots dusted with calcium arsenate alone there was severe and general burning of the foliage and most of the leaves dropped from the plants before picking time. Where the arsenic-copper-lime dust was used, the plants retained many more leaves than where calcium arsenate was used. Moreover, there were more berries and larger berries on the arsenic-copper-lime plots. Where DDT dust was used, the leaves apparently were not so severely burned as where calcium arsenate alone was used. The berries were small, however, and the crop was distinctly reduced on the plots to which DDT dust was applied.

Chemical analyses of dusted samples of fresh ripe blueberries showed no residue of DDT on any of the 5 samples tested; metallic copper varied in amounts from 5.5 to 12.5 ppm; and arsenic (AS_2O_3) varied from 0.8 to 11.8 ppm.

BLUEBERRY THRIPS. F. H. Lathrop. Applications of DDT dust and of benzene hexachloride dust during the early spring to areas of blueberry land heavily infested with thrips have failed to protect the plants from thrips injury. Tests are being continued to determine the effectiveness of DDT and other new insecticides applied later in the season for the destruction of the thrips after the injury has developed on the plants.

BLUEBERRY DISEASE CONTROL. A. E. Prince, Donald Folsom. Square rod plots were treated with 3 per cent Phygon, 5 per cent Yellow Cuprocide, 9 per cent Dithane, and 20-20-60 calcium arsenate-copper-lime dusts. Leaf rust, the prevalent disease, varied more from 1 blueberry plant group to another than from dusted to nondusted parts of the same plant group. Routine dusting in 1947 seemed to reduce the amount of twig blight carried over the winter of 1947-48.

BLUEBERRY WEED CONTROL. A. E. Prince, R. W. Buck. The relative effect of 14 different 2,4-D products on weeds and blueberry

plants is being studied with the hope that 1 may be found that will kill weeds without causing serious injury to blueberry plants. These 2,4-D weed killers included some dusts. Handy Killer containing sodium arsenite was used in an attempt to kill brake ferns and grasses. Du Pont Weed Killer (Ammate), containing ammonium sulfamate, was used on woody species known to be resistant to the 2,4-D materials. Other materials tried included Varsol which is a Stoddard's Solvent. The 2,4-D materials were mixed to a standard concentration of 1000 parts per million. The spray materials were applied to the plants until they were thoroughly wet, but not drenched. The dust materials were applied to get complete coverage of the foliage.

Because some species sprout the year after treatment and others that remain apparently uninjured for the first season do not overwinter, final notes cannot be taken until about July 1948.

Expected differences between 2,4-D salt and ester formulations are not evident at this time. Ester formulations are sometimes more effective than salts of 2,4-D. Ester formulations have the advantage that they are not washed off by rain as easily as the salt types. Because of drift it seems advisable not to use 2,4-D dust materials in blueberry fields unless there are special cases where the damage done the blueberry plants from drift of the dust may be less than the resulting benefits. It may be that Ammate can be used effectively on weeds resistant to 2,4-D materials.

There is ample evidence that the condition of the plant at the time of treatment with 2,4-D has considerable effect on the results obtained. For example, rapid growing, succulent sprouts are more easily killed than slower growing shoots. Consequently weeds can be killed more readily on land burned that season than on unburned lands.

Alders, sweet fern, birches and some willows are very easily killed with 2,4-D materials. Red maple, bunchberry, wintergreen, and brake fern and some grasses may be killed with a sodium arsenite material; while red maple, bunchberry, and wintergreen can be killed with Ammate.

FERTILIZER EXPERIMENTS WITH BLUEBERRIES. M. F. Trevett, C. W. Hitz. Experiments designed to study the effect of nutrient balance on fruit bud formation and of the effect of the time of fertilizer application in the cycle from "burn to burn," are being continued.

FIG. 2. The Blueberry Hand Transplanter Can be Used to Place Blueberry Sods into Areas Barren of Plants. On the left the planter is being used to obtain the transplants shown at right.

Sodium nitrate applied to plots in their first bearing year had no significant effect on the yield of that crop. There were indications, however, that fruit bud formation had been stimulated, which if consistent for all species should increase the yield of the second crop.

Observations were made in the spring of 1947 to determine the extent of winter injury on plots receiving increasing amounts of nitrogen. At the highest rate of application, 140 pounds of nitrogen per acre, no more winter injury was noted than occurred on the unfertilized plots. General observations made in fields in Washington County led to the conclusion that the extent of winter injury may be as much a function of the degree of exposure to the prevailing winds of winter as of nutrient balance.

BLUEBERRY SOIL INVESTIGATIONS. M. F. Trevett, P. N. Carpenter. Chemical analysis of blueberry soils did not reveal any over-all relationship between the level of available mineral nutrients, or of soil pH, and plant vigor. A highly significant relationship was found between per cent of soil organic matter and length of stem.

A NEW TOOL FOR TRANSPLANTING BLUEBERRIES. C. W. Hitz. Transplanting of blueberry sods has long been a recommended procedure for filling up bare places in blueberry fields. Transplanting with a shovel and spade has been a slow and costly procedure. Use of a golf-hole cutter, obtainable from any golf supply house, materially speeds up the process (Fig. 2).

In 1947 approximately 95 per cent of the transplants made before time of blooming survived the summer. The survival rate is drastically reduced when the transplanting is delayed until blossoming or afterwards. Spring transplanting is preferred to fall transplanting because in some soil types frost heaving may be very severe.

INCREASING PLANT STAND IN BLUEBERRY FIELDS. C. W. Hitz. A scraper hoe was used to cut the underground stems in a blueberry field. Preliminary analysis of the results shows that about ¾ of the cut stems produced new upright growth within ½ inch of the cut. There appears to be an insignificant amount of killing of old uprights by the treatment. Attempts to carry these results into commercial practice by the use of an ordinary disk harrow were unsuccessful. Although new uprights were produced, the killing

of old uprights was apparently too great to make the method feasible. However, if special equipment is developed to reduce the damage to the uprights, the cutting of the underground stems may become commercially important.

Rooting of Blueberry Cuttings. C. W. Hitz. Cuttings of 3 and 6 inches in length of underground stems (rhizomes) were planted in a field nursery plot in the spring of 1947 following treatments with certain chemicals. Treatment of the cuttings reduced the number of new uprights produced. Six-inch cuttings produced about twice as many new uprights as 3-inch cuttings. A nursery soil into which 3 inches of peat had been disked was a better medium for starting new uprights than a soil into which 3 inches of sawdust had been disked.

Greenhouse studies in 1947-48 verified earlier findings that treatment of cuttings with a preparation to aid in rooting (Hormodin #3) stimulated root formation but retarded the start of upright growth. Growing the cuttings in a blueberry bench soil was more advantageous for starting uprights. Earlier growth also may be obtained by placing the cuttings in a porous material (such as heat exploded mica, Vermiculite) which retains moisture, keeping the cuttings wet. Planting the cuttings in this material held at approximately ¼, ½, ¾ or full water-holding capacity of the medium did not influence rooting. The greatest number of uprights started at the higher moisture levels but the earliest start was at the lowest levels.

In a separate study of insufficient size for statistical analysis it was found that there is considerable difference in the opposite ends of the cuttings. At the time the cuttings were made, the end toward the old, above-ground upright was called the tip of the cutting, and the opposite end of the cutting was called the base. Of the 105 cuttings producing new upright growth, 93 had started uprights in the tip ⅓ of the cutting. Only 6 of the cuttings had uprights appearing on the basal ⅓ of the cutting. When the cuttings were treated on either end with Hormodin #3 there were about 3 times as many roots as on the untreated cuttings. When treated on the tip end, however, the number of uprights was materially reduced, resulting in an average of only ⅓ upright per cutting. In contrast there were 2 uprights per cutting when untreated or treated on the base end. This experiment indicates that Hormodin #3 can

be used effectively if the cuttings are treated on the base end, thereby increasing the number of roots without decreasing the number of uprights.

ARTIFICIAL POLLINATION OF BLUEBERRY FLOWERS. C. W. Hitz. Several materials were tested in attempting to secure artificial pollination of blueberry flowers in 1947. The materials used at 5 weekly applications during blossoming were 4-Chlorophenoxyacetic acid-naphthoxyacetic acid mixture applied as a water spray;[1] Indolbutyric acid (Aerosol) applied as a mist at 500 ppm; 4-Chlorophenoxyacetic acid applied at 5 and 10 ppm; and "Fruitone" applied as a water spray at normal and twice normal concentration. Unanalyzed data indicate that the indolbutyric acid applications are the only ones with promise. The percentage fruit set on treated flowers protected from bees was 2.5 compared with 0.48 per cent on untreated flowers. Some seedless fruit matured within the treatment. On open-pollinated areas none of the treatments gave a higher percentage fruit set than the untreated areas.

OIL BURNERS FOR BLUEBERRY LAND. G. W. Wilson, C. W. Hitz, S. W. Prout.[2] Since before World War II, the Experiment Station has been interested in the development and operation of oil burners for burning blueberry land. Commercial oil burners are now available that are adaptable to a wide range of burning conditions. Successful burning has been accomplished in fall and winter allowing maximum benefit to the blueberries, easier fire control and game conservation. In many cases burning with oil may be more economical than burning with hay. In the spring of 1948 approximately 12 acres were burned per 8 hour day using a modern type burner (Fig. 3).

The fuel cost averaged about $14.00 per acre. Including labor, depreciation and all other costs, it was estimated that average blueberry land can be burned with this machine at a cost of $17.00 per acre. Observations, concerning the adaptability and efficiency of the machine and the residual effects on the blueberry, will be continued.

---

[1] Consisting of 40 per cent of the 4-Chlorophenoxyacetic acid and 60 per cent of naphthoxyacetic acid, applied at 20, 40, 80, and 120 parts per million.

[2] Cooperative study with Mr. Prout who is a member of the Blueberry Industry Advisory Committee and who operates the oil burner shown in Figure 3.

FIG. 3. Operation of Commercial Oil Burner for Burning Blueberry Land.

CORN

SWEET CORN BREEDING AND VARIETY TRIALS. R. M. Bailey. Approximately 1000 plots at Highmoor Farm in 1947 were devoted to the testing of breeding stocks and new hybrids. Replicated yield trials in 1947 supported previous conclusions that Dirigo, Carmelcross and Seneca Golden are excellent early yellow canning hybrids and Maine Tricross and Hybrid C for late yellow hybrids. No satisfactory white hybrids have been located as yet. Several new promising yellow hybrids were located last season and these will be more thoroughly tested in the near future.

For the home gardens of northern and eastern Maine, Northland and Sugar and Gold are good first early hybrids. Early Golden 1.13 ripening about 5 days later and Carmelcross about 10 days later are excellent to follow these. Golden Cross Bantam is recommended for late season in the central and southern part of the State.

Early, midseason, and late hybrids suggested for the market grower are Spancross, Early Golden 1.13, Carmelcross, Pilgrim, and Golden Cross Bantam, which ripen in the order listed.

EUROPEAN CORN BORER. J. H. Hawkins, B. E. Plummer, Jr., A. S. Getchell. European corn borer injury resulted in losses of about $60,000 to the Maine processor of sweet corn during 1947. Direct injury to corn caused additional losses to growers. It is necessary to control the European corn borer in order to continue economic production of corn grown for processing.

An important source of European corn borer infestation is the result of corn stalks present on the surface. Especially dangerous are stalks left on the surfaces of fields and gardens after the soil has been prepared for spring planting. In order to reduce this source of infestation it is recommended that (1) all corn stalks be deeply and cleanly plowed under; (2) that exposure of corn stalks be avoided when harrowing or cultivating, (3) that all corn stalks or other plant material left on the surface when the soil is prepared for spring planting be destroyed. Two or 3 dollars expended before July 1 in removal and destruction of exposed corn stalks may save the considerably greater expense of applying insecticides later.

Insecticides will prevent destruction of corn by the European corn borer even when cultural control practices have not been fully successful. Ryania sold as a 40 per cent dust under the trade name

of "Ryanex 40-D" and for use as a spray under the trade name of "Ryanex 100-S" is effective in European corn borer control. Ryania is reported to be safe for use when the treated corn is to be fed to livestock. DDT in the form of dust or spray is also effective, but it cannot be recommended when any part of the treated corn plant is to be fed to livestock.[3, 4]

The fall armyworm was present in corn ears during 1947 and the corn earworm affected sweet corn in some areas. The control of these two insects is being studied when insecticides are applied for the European corn borer. A 5 per cent DDT dust shows promise as an insecticide for the fall armyworm.

CONTROL OF WEEDS IN CORN BY CHEMICAL HERBICIDES. ***Experiments with Sweet Corn at Highmoor Farm.*** A. E. Prince, R. M. Bailey. Excellent control of broad-leaved weeds and also of barnyard grass resulted with 1 treatment of Sinox applied 2 or 3 days after the corn emerged ("spike" stage, leaves not unrolled), at a rate of 150 gallons per acre with a concentration of 1 gallon of material in 100 of water. This treatment caused no significant damage to the corn plants. A concentration of 1 gallon of Sinox to 50 gallons of water was slightly more effective in weed control but resulted in somewhat more damage to the corn plants. A concentration of 1 to 200 proved to be too weak for effective control. All 3 concentrations applied at later dates, after the corn leaves had unrolled, resulted in more damage to the corn plants and were less effective in weed control. Sinox at the 1:100 concentration apparently is effective for weed control in sweet corn when applied 2 or 3 days after plant emergence under cool and wet spring conditions when weeds are most troublesome. If Sinox is applied after corn leaves have unrolled, fan shaped sprays should be used to direct the material to the base of the plant to avoid accumulation of the spray at the base of the leaves or in the whorl of young leaves.

Sinox W was also tested at several concentrations and timings but this material proved to be too toxic to sweet corn to offer much

[3] Composite samples of the entire sweet corn plant examined for DDT residues contained 0.64 ppm for plots receiving 4 applications, 0.46 ppm for 3 applications, and no DDT for untreated plots.

[4] More detailed information on the control of the European corn borer is available in Maine Extension Circular 247, The European Corn Borer and Its Control, by John H. Hawkins and Joseph C. Hickey, April, 1948.

promise unless applied as a fan-shaped spray directed to the base of the plants.

Granular cyanamid, applied broadcast at 100 pounds per acre immediately following the planting of sweet corn, reduced the population of broad-leaved weeds, mostly kale and red root pigweed, to an appreciable extent but not sufficiently well to encourage further use of cyanamid as a practical agent for this purpose. Both the corn and remaining weeds exhibited stimulation of growth as a result of the additional nitrogen.

Nutgrass Control wi.h 2,4-D in Western Maine. A. E. Prince. Formulations of 2,4-D, including butyl ester, isopropyl ester, monohydrate sodium salt, morpholine salt, triethanolamine salt and sodium salt, were tested in 1947. Because an early frost killed the weed plants before final notes could be taken, no records were made as to the reduction in stand, but samples of fruiting heads were taken for seed viability tests and soil samples were taken to determine the effect on nut production. None of the materials completely controlled viable weed seed or nut formation but, in general, salt formulations were definitely superior to ester types. Fairly effective use of the salt formulations was obtained from 2 applications of spray at a concentration of 2000 ppm at a rate of 100 gallons per acre. The best control was obtained in a single plot which received 2 spray treatments of the morpholine salt at a concentration of 4000 ppm at a rate of 200 gallons per acre. Dust formulations of sodium salt were not as satisfactory as the spray materials.

Experiments in 1946 indicated that ineffective results were obtained from 2 applications of 1000 ppm, or from 1 application of 2000 ppm. Plots receiving 3 applications of 2000 ppm had a 77 per cent reduction in the number of green plants produced, an 11 per cent reduction in inflorescences, and a 44 per cent reduction in the number of nuts formed. None of the weed seeds produced in the treated plots germinated, while 34 per cent of the seeds produced in the untreated plots were viable.[5] A comparison of results in 1946 and 1947 indicates that a higher concentration of 2,4-D is required in a dry year than in a wet year.

All of these 2,4-D treatments that were effective in controlling

[5] The seed viability tests were made by Joanne Goodine of the Seed Analysis Laboratory.

nutgrass or foxtail grass will result in severe damage if applied to fields of growing corn.

The plots were almost completely overrun with the foxtail grass (Setaria glauca) except in the 1 plot that received the heavy dosage of the morpholine salt. In this plot the foxtail grass was almost completely controlled. The sodium salt, however, caused a greater reduction in the number of viable weed seeds produced.

FIELD CORN INVESTIGATIONS. R. M. Bailey, C. H. Moran, B. E. Plummer, Jr., A. S. Getchell. Variety trials at Highmoor Farm of flint, flint-dent, and dent corn varieties and hybrids indicate that the most promising material for Maine is a group of flint-dent hybrids. One of these, Maine B (Wisc. 240) is produced locally and is available to farmers through several commercial seed houses. Over the past 7 years this has yielded an average of 70 bushels per year of air-dry corn. Maine B has outyielded native open-pollinated flints grown during the same period by approximately 35 per cent and has matured practically as early. Two other flint-dent hybrids, KF1 and KF5, are available and appear to be similar and equal to Maine B. A dent hybrid that has been sufficiently early maturing and productive at Highmoor to recommend it for trial for grain in southwestern Maine is Mass. 62. Flint hybrids are needed for the short season locations requiring earlier maturity than Maine B but none is recommended at present. Several experimental hybrids are under observation.

Samples of shelled corn from the 1946 and 1947 Highmoor trials were subjected to feed analysis. The greatest differences were found to be in the protein values of the 3 kernel types.

Type	No. of varieties	Protein per cent (av.)	Protein per cent (range)	Fat per cent (av.)
Flints	6	14.2	14.6-13.5	5.3
Flint-dents	7	12.5	13.2-11.5	5.4
Dents	4	11.6	12.2-11.2	4.7

The results of an ensilage variety trial conducted at Highmoor Farm are shown in the following tabulation, with the varieties listed in order of early to very late maturity.

Variety	Tons/A green	Tons/A dry	Protein lbs./A	Fat lbs./A	NFE lbs./A
Maine B	15	4.2	816	215	4822
Mass. 62	18	4.4	765	192	4875
KD-4	20	4.4	756	173	5174
Cornell 29-3	22	4.9	900	170	5645
Red Sweepstakes	24	4.9	775	128	5302

Although yields of green tonnage per acre ranged from 15 for the early Maine B to 24 for the late Red Sweepstakes, there were surprisingly small differences between the varieties in the yields of dry matter and feed nutrients. Perhaps the use of relatively early maturing varieties even for ensilage should be stressed in a short season area like Maine because of better earing and equal or better yields per acre of protein and fat.

CUCUMBERS

BREEDING SCAB RESISTANT CUCUMBERS. R. M. Bailey, A. A. Virta, Donald Folsom. Since the release of Highmoor, which is a scab-resistant slicing type, major emphasis has been placed on developing a satisfactory scab resistant pickle type variety. Resistant breeding stocks have been crossed with National Pickling and resulting progenies are now under study.

DAIRY

COSTS OF PRODUCING AND DISTRIBUTING MILK. G. F. Dow. The results of these studies, made in cooperation with the Maine Milk Control Board, have been published in 2 bulletins. These reports, which contain a summary of costs and also an analysis of a number of factors that affect costs of production and distribution, are:

Bulletin 451, Costs of Distributing Milk in Maine Markets, by Alvah L. Perry, July 1947.

Bulletin 456, Costs and Returns in Milk Production for Local Maine Markets, by Alvah L. Perry and George F. Dow, October, 1947.

MILK PRICING. G. F. Dow. Information from the studies in Maine as to milk production costs and seasonal milk production were used in connection with the development of the Boston Price Formula for Class I milk which became effective April 1, 1948. The price committee of 8 economists, including George F. Dow from the Maine Station, prepared both a technical and a condensed report. The results of their cooperative research were published in September, 1947, by the Market Administrator under the title, A Recommended Basis of Pricing Class I Milk in the Boston Market.

SEASONAL VARIATION OF MILK PRODUCTION. G. F. Dow, H. A. Luke. Some of the results of this study have been published as Maine Agricultural Experiment Station Bulletin 459, Factors Affecting Seasonal Milk Production and Their Effect on Producers' Costs and Returns, April, 1948. This report was prepared by a subcommittee involving cooperation of State Agricultural Experiment Stations and the Bureau of Agricultural Economics, U. S. Department of Agriculture. The material includes an analysis of the problem of seasonal milk production, factors affecting seasonal output, and variations in inputs and net costs associated with different seasonal patterns of milk production.

A more detailed analysis of seasonal milk production in Maine is being prepared for Station publication. This study is based on dairy farm management surveys including 989 Maine farms and various milk marketing studies. The analysis shows the trend toward more uneven milk production and various factors affecting seasonal milk production such as season of freshening, feed and weather conditions, and milk pricing plans. Also discussed are some of the problems involved in the utilization of surplus milk and in obtaining supplementary fluid milk supplies from other markets.

Additional study of seasonal milk production for the entire Boston Milkshed is provided for in a cooperative study with the U. S. Bureau of Agricultural Economics, the Boston Milk Market Administrator, and the Maine, New Hampshire, and Vermont Agricultural Experiment Stations. Analysis has been made of data in the Market Administrator's Office covering milk deliveries during the past 10 years for a number of country plants and selected milk producers. The study was continued in June 1948 by obtaining detailed data as to the difficulties involved in making seasonal adjust-

ments by the producers selected in representative areas of Maine, New Hampshire, and Vermont.

CONSUMPTION OF DAIRY PRODUCTS. H. A. Luke. This project was undertaken as part of the Northeast regional dairy marketing program. Interviews were conducted during April 1948 with about 700 families in the Portland market for the purpose of obtaining information about the use of dairy products. Consumer response to price changes and attitude toward economy measures in distribution also were observed. Additional related information was obtained from milk dealers and other agencies. Changes in the use of dairy products can be determined by comparing current consumption with that of prewar when a previous study was made. The results of this study will furnish valuable information in maintaining and expanding markets for dairy products.

REDUCING LOSS OF BUTTERFAT TEST IN COMPOSITE MILK SAMPLES. L. M. Dorsey. Continued study of the butterfat tests of 15-day composite milk samples, made up from a.m. and p.m. samples of the milk from the University of Maine dairy herd and preserved with standard preservative (mercuric chloride), compared with the average test of the fresh milk, revealed losses in butterfat test ranging from 0.042 per cent to 0.143 per cent, equivalent to losses in butterfat weight credit of 0.96 per cent to 3.18 per cent.

Two lots of mixed milk from a commercial receiving plant preserved with mercuric chloride held 15 days lost 0.1 per cent in butterfat test. This amounted to a fat weight credit loss of 2.4 per cent for one lot and 2.7 per cent for the other. A prepared sample of mixed milk from 19 cows secreting milk that developed positive rancidity in 24 to 48 hours, preserved with mercuric chloride, decreased in butterfat test 0.15 per cent in 15 days. This was equivalent to a loss in fat weight credit of 3.33 per cent.

When acetophenone was used in conjunction with a standard preservative (mercuric chloride, formaldehyde, or silver nitrate) there was no loss in butterfat test in composite milk samples composited over a 15-day collection period. It should be understood that the lipase enzyme inhibitor does not compensate for faulty processing of a composite sample in preparing it for testing. It was discovered also that acetophenone when used alone not only inhibits lipase enzyme activity, but in addition acts to prevent bacterial activity thus presenting the possibility of its use as an ideal preserving agent for commercial composite milk samples.

DAIRY FARM CHEESE. L. M. Dorsey. Additional attention was given to the use of a commercial enzyme preparation (Italase) as a substitute for rennet paste as an accessory flavor developing agent for the farm dairy cheese. However, because of limitation as to availability of this material at the present time it is not possible to release the cheese making method to the public.

CALFHOOD VACCINATION TO CONTROL BANG'S DISEASE. J. F. Witter. During the past 2 years, milk samples have been sent in from animals properly vaccinated as calves, which either continued to react or subsequently reacted as adults. A total of 21 milk samples from 21 problem cows were injected into guinea pigs and the results observed. Seven guinea pigs died promptly as a result of contaminated samples. Of the remaining 14, 4 developed a blood reaction to the Bang's test and 2 of these showed lesions. All 4 of these calfhood vaccinated animals were between 3 and 4 years of age. Three had been negative to the test and subsequently reacted while 1 continued to react. Three of these aborted and in one case the Brucella organism was isolated via the guinea pig from the placental fluids. Of the remaining 10 animals whose milk did not induce any guinea pig reaction, 5 were reactors from the time of vaccination, 4 reacted as adults and 1 was suspicious. The majority of the cows involved in the 21 tests were from herds where there had been a flare-up and the vaccinated animals reacted.

This work, while limited in scope, does definitely prove that properly calfhood vaccinated animals which continue to react as adults or which subsequently react as adults can be spreading the Bang's infection in their milk and in the fetal membrane discharges.

CONTROL OF MASTITIS. J. F. Witter, H. C. Dickey. A total of 80 cows and 1376 quarters in the University herd were tested during the year to April 21, using the pH tests, Hotis tests and microscopic examination of incubated sample smears. Thirty-seven cows were found to be positive in one or more quarters during the year. Eighteen were positive at the beginning of the year, 19 developed mastitis during the year, and 18 were positive at the end. There were only three quarters which "flared up" during the year. Because of the benign nature of mastitis in the herd only 5 cows were treated. Of the 5 cows treated, 3 were negative at the end of the year. Of the 32 mastitis cows not treated, 16 were negative at the end of the year. There is considerable fluctuation in the tests on so-called positive cows. Once a quarter becomes definitely in-

fected, however, it will continue to react month after month. Mastitis has not been an economic factor in the herd this year.

POSSIBLE MINERAL IMBALANCE IN DAIRY CATTLE. H. C. Dickey, B. E. Plummer, Jr. Ten Jersey cows were divided into 2 groups of 5 each. One group was fed hay grown at Highmoor Farm, the other hay grown at the University Farm in Orono. Blood samples were taken from each of the cows and the serum analyzed for sugar, sodium, potassium, calcium, and magnesium. There was some difference in the composition of the serum from individual cows but no significant differences in the average composition of the 2 groups.

INHERITANCE IN DAIRY CATTLE. H. W. Hall, H. C. Dickey. Pedigree information on proved sires shows that the best measure of a young dairy bull's transmitting ability is to average the production records of the daughters of the bull's sire, maternal grandsire, and maternal great grandsire. The average production record of the dairy bull's dam alone is of little value as a guide to her son's transmitting ability. Cow families are now being thoroughly investigated to evaluate their worth in the selection of dairy herd sires.

USE OF FOUR PER CENT FAT CORRECTED MILK PEDIGREE IN SELECTING THE DAIRY HERD SIRE. H. C. Dickey. This study is being made to determine to what degree the energy value of milk is inherited in dairy cattle. Pedigrees have been worked out on 89 proved sires having no less than 5 proved sons each or an actual total of 784 proved sons. Since work was rather recently initiated, no data are available at this time.

EFFICIENCY IN HARVESTING HAY. G. F. Dow. The results of this study have been published in 2 reports:

Bulletin 453, Labor Efficiency in Harvesting Hay by George F. Dow, August 1947.

Miscellaneous Publication No. 606, Improving Haying Efficiency Through Changes in Work Methods, A Case Study of Buckrake Operation, by Irving F. Fellows, Bureau of Agricultural Economics, U. S. Department of Agriculture, July 1947, 9 pages mimeographed.

The first report analyzes labor requirements using different types of equipment. The second report indicates haying efficiency on one farm could be increased more than 40 per cent through better work methods and minor adjustments in equipment and buildings.

ARTIFICIAL HAY DRYING. C. H. Moran, H. C. Dickey. In June 1947, the ailerons were installed to prevent the overloading of the 5 horsepower motor. A 7½ horsepower Westinghouse motor was previously used.

One lot of hay was dried on the conventional mow drier and a similar lot was field cured. Two groups of beef steers were wintered on these hays, so that a comparison can be made. Another lot of approximately 15 tons of hay was dried in a conical bin drier (Martin Haymaker) using heated air.

The cost of drying 20 tons of hay on the conventional mow drier was approximately one dollar per ton, providing the electricity cost one cent per kilowatt hour. Although the results of the steer feeding trial are not complete, yet the preliminary results show that the field-cured hay is equal or slightly superior to the mow-cured hay on an equal weight basis. The results would indicate that the mow curing of hay costs more than field curing. Mow curing does offer a means of preventing some hay from being rained on because it can be placed on the flues at a higher moisture content.

INFLUENCE OF THE FEED FED DAIRY COWS ON RUMEN DIGESTION OF CRUDE FIBER AND THE SYNTHESIS OF THIAMIN AND RIBOFLAVIN. H. C. Dickey, J. F. Witter, B. E. Plummer, Jr., A. S. Getchell. A total of 9 digestion trials were conducted, 6 with a Hereford steer with a rumen fistula and 3 with a normal Hereford steer. The trials consisted of a 7-day preliminary period and 10-day collection period. The steer was fed a weighed amount of feed and the feces were collected and weighed each day. The feed, feces, and rumen contents were sampled each day during the collection period and these samples were stored until the experimental period was completed, then they were composited and analyzed.

The rations fed were timothy hay, timothy hay and ground corn, timothy hay and soybean oil meal, ladino-timothy mixture (50-50), ladino-timothy and corn, ladino-timothy and soybean oil meal.

The digestibility of each ration was calculated. The digestibility of protein was higher on rations that were high in protein. The digestibility of ether extract material was variable with no definite trend. The digestibility of crude fiber was increased when corn or soybean oil meal was added to the ladino-timothy mixture. When corn was added to the all timothy ration the digestibility of crude

fiber was not increased; but it did increase slightly when soybean meal was added. The digestibility of the nitrogen-free extract was fairly constant with one exception. On the ladino-timothy and corn ration the digestibility of nitrogen-free extract was about 8 per cent higher than when the ladino-timothy was fed alone or with soybean oil meal. The rumen digestion of crude fiber was determined by the lignin ratio method. It was found that 50 per cent of the crude fiber was digested by the rumen in each of the 6 rations fed. This represents about 75 per cent of the crude fiber digested by the entire digestion tract of the bovine. No differences in digestibility were observed between the normal steer and the steer with the rumen fistula indicating that normal digestion coefficients can be determined using a rumen fistula steer.

FORESTRY

BOARD FOOT-CORD RATIO TABLES. R. I. Ashman, H. A. Plummer. The purpose of this project is to assemble data for the construction of board foot and cord volume tables for spruce, fir, hemlock, and white pine. Additional measurements of felled spruce and fir were made on Indian Township and of small white pine in Liberty and Chelsea.

INCREASED PRODUCTION OF NORTHERN WHITE PINE. R. I. Ashman. The federal government and the St. Regis Paper Company experimented with broadcast seeding of white pine from airplanes on burned areas in York and Washington Counties but data covering costs and results are not yet available.

Seed spots established on the University Forest near Stillwater have been checked and survival is still good.

Small plots have been established on an area where partial cutting was practiced in 1946 to ascertain the quantity of white pine reproduction resulting from the heavy seed crop last fall.

Seed spots are being established in the University Forest on bare ground, on a small burned area, and on grass-covered areas using white pine pellets. These pellets are seeds encased in fertilizer and should give much more satisfactory results than untreated seed. Similar experiments are being carried out on a small scale in the recent burns.

The State Forest Nursery has supplied 200 Norway pine and

100 white pine for experimental planting on the burned-over area near Kennebunkport, and the Western Maine Forest Nursery has supplied some planting stock to be used on other parts of the burn in western Maine.

A preliminary report on forest planting with particular emphasis on white pine will be ready for circulation this summer. If planting stock is available at reasonable cost, there will be considerable reforestation on the burned areas in Maine.

MANAGEMENT OF SMALL WOODLAND AREAS IN MAINE. R. I. Ashman, F. E. Holt. Case histories of managed woodlands are being obtained through cooperation with the Extension Service and with the Soil Conservation Service, but few farmers have satisfactory records of their woodland operations. Consequently progress on this project has been very slow.

ARTIFICIAL PRUNING. R. I. Ashman. In this treatment, the buds are removed which would form the branches in the top whorl, thus assuring the formation of knot-free wood as the tree increases in diameter. Ladders are now necessary for carrying on this work and the extreme flexibility of the trees makes bud pruning difficult.

RED PINE SAWFLY. R. I. Ashman, Gregory Baker. The infestation of red pine sawfly was light last summer. The stand appears normal but increment borings show that diameter growth is still smaller than before the first heavy attack by the insect. Crowding may be partly responsible for this condition and the stand will be thinned to produce material for use in the fence post project.

SERVICE LIFE OF MAINE WOODS FOR POSTS. Gregory Baker. Work on this project was continued this year with the preparation of 50 posts from thinnings in a Norway pine plantation on the University Forest. The project has not been continued long enough to furnish any data on relative durability of the species used.

SEASONING OF MAINE WOODS. Gregory Baker, F. K. Beyer. Work was initiated in western Maine to determine the effect on the rate of air seasoning of 4 different methods of piling turnery squares. Four piles each were erected in July, September, December, April, and May. Moisture content determinations were made periodically with an electric moisture meter on 30 sample bars distributed through each pile. Final data will not be available until the last series of piles are seasoned.

An experiment on the application of chemicals to thick beech

lumber to prevent or reduce seasoning checks was carried on at Old Town, in cooperation with the U. S. Forest Products Laboratory and the Forest Utilization Service. The chemical used was buffered sodium chloride applied by spraying, dipping, and spreading dry salt on bulk piled lumber. In the latter process the lumber was left in the solid pack for about a week and then piled in the conventional manner. Based on a mill-run study of the treated lumber, the latter method of application gave the best results. More details are available in U. S. Forest Products Laboratory Report No. R1708, "Chemical Treatment and Seasoning of Thick Beech Stock."

Data were collected from 4 U. S. Weather Bureau stations in Maine and analyzed to determine the effect of weather on the air seasoning of wood in different months of the year. This information is presented in detail in Maine Agricultural Experiment Station Misc. Pub. No. 607, "The Effect of Weather Upon the Rate of Air Seasoning of Wood Products in Maine."

A small experimental fan dry kiln, loaned by the U. S. Forest Products Laboratory, has been used for the past year in working out satisfactory kiln drying schedules for various species and products. Several charges of 2¼-inch beech turnery squares have been run in working out a schedule to give the most rapid drying consistent with the lowest amount of seasoning degrade. More work needs to be done on this phase.

Experimentation in cooperation with 2 local turneries was carried on in working out drying schedules for green, rough-turned stock. This work is still in progress but gives promise of being successful in materially shortening the seasoning time and reducing the seasoning degrade.

PREVENTION OF STAIN AND DECAY IN BIRCH TURNING BOLTS. M. T. Hilborn, A. E. Prince. This is a cooperative project with the U. S. Forest Service and the U. S. Department of Agriculture, Division of Forest Pathology. Birch turning bolts to be used in the manufacture of various wood products are being cut and stored at different times of the year. Various treatments are being tested, including several kinds of end coatings and also spraying the ends of bolts with a chemical wood preservative.

BRONZE BIRCH BORER. C. O. Dirks. Infested wood was assembled for caging during 1948 for life history observations on the bronze birch borer.

SPRUCE BUDWORM. C. O. Dirks. Assistance was given throughout the spring and summer of 1947 in the studies relating to the natural control of the spruce budworm at the Laboratory of the Bureau of Entomology (U.S.D.A.) at Lake Clear Junction, New York. The studies started in 1946 were continued without change in procedure in 1947.

The season of 1947 was marked by a tremendous reduction in the infestation of the budworm in the entire region of the Adirondacks of New York. During the winter of 1946-1947 a high proportion of the hibernating larvae were killed by natural causes. In the spring and early summer, during the larval and pupal stages of the budworm, the attack of the different species of parasites was higher than in 1946. A small hymenopterous parasite (*Dicladocerus* sp.) was especially more abundant than the previous year. On 11 different study plots, the work of parasites was carefully studied and measured at frequent intervals during the season. In addition, considerable numbers of unmeasured factors caused important reductions in the population of the budworm. Among these were birds and spiders.

The following is a list of the parasites which attack the spruce budworm in the Adirondack region of New York:

Apantales fumiferanae (Vier.)
Glypta fumiferanae (Vier.)
Itoplectis conquisitor Say
Ephialtes ontario Cress.
Nasonia tortricis Brues
Phryxe pecosensis T. T.
Aplomya caesar Aldr.
Dicladocerus sp.

Although the spruce budworm has been collected in small numbers in Maine for several years, the infestation increased to a considerable degree in 1947, especially in the vicinity of Moosehead Lake and the Ashland area. Under the direction of the Maine Forest Service a well-trained group of forest rangers make frequent and deailed collections in the forest regions of the State.

GRAIN

SMALL GRAIN TRIALS. C. H. Moran, W. C. Libby, R. M. Bailey. Tests of a selected group of wheat, oat, and barley varieties were made in cooperation with the Division of Cereal Crops and Diseases at Highmoor and Aroostook Farms. The yields obtained during 1947 were the lowest reported for a number of years. One late spring wheat variety, Frondoso, was outstanding in production of leafy material, and will be further tested for use in southern Maine. The two leading oat varieties were Beaver and Zephyr. Beaver is an introduction from Canada and ranked highest in the New England trials. The leading barley varieties in the 11 states test were Vantage and Trebi.

HOGS

SWINE FEEDING. H. W. Hall, H. C. Dickey, F. J. McDonald, B. E. Plummer, Jr. Three pigs that had access to cow manure and were fed about 75 per cent as much concentrates as another group of 3 pigs in dry lot, consumed 193 pounds of grain per 100 pounds gain. In contrast, those not having access to manure consumed 299 pounds of grain per 100 pounds of gain. The group on cow manure for a 103-day period produced 73 more pounds of pork on 325 less pounds of concentrates. None of these pigs had access to pasture or direct sunlight but received vitamins A and D and minerals. The dry-lot pigs received about one-quarter pound of grain daily for each week the pig was of age.

In a second experiment one lot of pigs was fed a ration consisting of 5 parts of hominy feed, 2 parts of 16 per cent protein dairy ration, 1 part of alfalfa meal, 1 part of wheat standard middlings, and 1 part of Maine concentrate fish meal. A second lot receiving dried cow manure in place of alfalfa meal made slightly more economical gains than the other group. Both rations were fed in self feeders. The return above feed cost per hog, when sold for $22 per 100 pounds of live weight, was $4.18 per hog fed dried manure and $3.09 per hog fed alfalfa meal.

SWINE BREEDING. H. W. Hall, H. C. Dickey. A litter of Yorkshire-Chester White crossbred pigs were narrower across the loin and smaller in the heart girth than another litter of Hampshire-

Chester White crossbreds. At 6 months of age the former cross averaged 227 pounds and the latter cross 246 pounds per hog. The carcass quality of the Hampshire-Chester White hogs was slightly better because of more finish and a higher percentage of lean to fat. The Hampshire-Chester White hogs dressed 77.8 per cent as compared with 78.6 per cent for the other group.

HOME ECONOMICS

COMPARISON OF DIFFERENT MODELS AND SIZES OF KITCHEN SINKS. Merna M. Monroe. Dishes, milk pails, and a milking machine were washed and rinsed in different types of sinks according to methods commonly employed by homemakers, as reported in answers to a questionnaire. In so far as convenience is concerned, it was found that either the single-basin sink that is 30 inches long or the double-basin sink in which each basin is 17 to 20 inches long was adequate. The single-basin sink that is 20 inches long was inconvenient because there was not enough room in the basin to accommodate both the washing and the rinsing. If dishes are rinsed by pouring or spraying water over them while they are in a dish drainer, the drainer should be put in the sink basin instead of on the drainboard to prevent splashing of water onto the floor. The dishpan can be put on the drainboard or on the work counter so as to leave room for the drainer in the sink basin. But most women who are no taller than 5 feet 2 inches will likely find it uncomfortable to reach up over the sides of a dishpan when it is put on the drainboard or work counter. Likewise, the short sink of the combination sink and laundry tub does not have enough room for both washing and rinsing in the sink basin. However, the homemaker could comfortably use the laundry tub section if she had a rack suspended in the tub, not placed across the top as is the drainboard. The rack should provide a platform about 5 inches below the top rim to give a comfortable working height when the dishpan rests on it; the drainer could be put in the sink basin.

Cardboard models of 6-inch-deep and of 8-inch-deep sinks were exhibited during Farm and Home Week. Nearly all of the 102 women who tried "working" at these sinks found the 6-inch deep sinks more comfortable than the 8-inch-deep sinks. More than half of those women who preferred the 6-inch-deep sink liked

it placed 38 inches rather than 36 inches from the floor; that is, the rim of the sink and the work counters at each end were 38 inches from the floor. With few exceptions, those who commented on the width of the rim at the front of the sink did not like having to reach over the 3-inch wide rim; they definitely preferred a rim no wider than 1½ inches.

SURVEY OF FARM-HOME NEEDS AND PREFERENCES FOR WORKING AND STORAGE SPACES. Merna M. Monroe. This is the Northeastern regional co-operative project with the Bureau of Human Nutrition and Home Economics at Washington, D. C. A total of 545 rural homes in 6 counties in Maine and in 5 counties each in New Hampshire and Vermont as designated by the national sampling agency have been visited. Eighty schedules have been taken from the 101 eligible families which met the definitions of the study. The information obtained from the surveys will be summarized and used as a basis on which to design minimum but adequate and convenient storage and working spaces for the farm home.

THE NUTRITIONAL STATUS OF JUNIOR HIGH SCHOOL PUPILS IN THE CITY OF BANGOR. Mary M. Clayton, Dorothy E. Ullman, Prudence Higgins. This project is part of a regional nutrition study in cooperation with Massachusetts, New Jersey, New York, Rhode Island, and West Virginia. Diet records for 5 days were secured for 430 junior high school pupils in Bangor, Maine, starting in March 1948. Individual dietary interviews were held with 100 of these pupils. Each child has also had a physical examination for nutritional defects by Dr. Wilbur B. Manter, Bangor physician. In addition, finger-blood samples were taken for the determination of hemoglobin, vitamin C, vitamin A, carotene, and phosphatase by the use of new microchemical methods. The completed summary for hemoglobin shows that 64.8 per cent of the boys and 60.5 per cent of the girls ranked excellent or good and 36.6 per cent of the boys and 39.4 per cent of the girls ranked fair or poor. The complete results of these blood tests should be of considerable value in indicating the adequacy of the recent diets of the children.

LETTUCE

CONTROL OF YELLOWS DISEASE OF LETTUCE. M. T. Hilborn, B. E. Plummer, Jr., A. S. Getchell. DDT was most effective for

the control of the insect vector of lettuce yellows with rotenone second and sabidilla showing little promise. Chemical analysis showed that no appreciable residues of DDT could be found if applications were discontinued before the plants began to head in the field.

PEAS

LIMING, FERTILIZER AND SEEDING RATE EXPERIMENTS ON PEAS FOR PROCESSING. G. L. Terman, S. C. Junkins. In liming experiments at Aroostook Farm, application of 300 pounds of ground limestone down the drill spout with the peas at seeding increased yields of shelled peas from 400 to 500 pounds per acre, as compared to yields without this lime application. In general, this small application of lime with the seed was much more effective in producing vigorous growth of vines and higher yields than broadcast applications of 500 to 1500 pounds of ground limestone per acre. The small application of lime with the seed is especially desirable on potato soils because a sufficiently large application broadcast may cause potato scab.

In a fertilizer experiment at Aroostook Farm, application of 500 and 1000 pounds of 5-9-9 per acre broadcast on peas resulted in no increase in yield, as compared to plots on which fertilizer was applied only for the previous potato crop. In another experiment application of potash fertilizer for peas increased yields slightly.

Peas drilled at the rate of 4 bushels per acre at Unity in central Maine yielded nearly 1400 pounds more shelled peas per acre than where 2 bushels were seeded. Certain sample areas from the 4 bushel rate of seeding yielded more than 2½ tons of shelled peas per acre. Application of sulfate of ammonia at rates of 50 and 100 pounds of nitrogen per acre increased the growth of vines, number of pods and potential yield over plots receiving 1000 pounds of ground limestone only or neither lime nor fertilizer. Application of nitrogen also appeared to keep the peas in condition for a high quality pack over a much longer period.

Pea aphid observations by J. H. Hawkins indicated only minor injury to canning peas during 1947.

POTATOES

POTATO TOP KILLING. A. E. Prince, P. H. Plaisted, R. W. Buck, B. E. Plummer, Jr. In the 1947 field experiments the following materials were used: Dow 66, Sinox, Sinox W, Varsol, Handy Killer, Cyanamid Aerodefoliant, Potassium Cyanate, Sodium Acid Cyanide and the English material, Lotemcide. These materials were tested on Katahdin, Green Mountain, Cobbler, and Chippewa varieties. Observations were made on potatoes top killed with Vine-Kil, Pennite 6, flame burners, and frost.

A satisfactory kill was obtained with most of the materials used if they were applied so that 100 per cent coverage was obtained and if they were applied under conditions favoring their action. Varsol, a Stoddard's Solvent, with 25 per cent number 2 fuel oil did not give a satisfactory kill.

Vascular discoloration was found in potatoes following the use of all materials or methods used or observed, but definite varietal differences as to the amount of discoloration were present. In the experimental plots, Chippewas were the most severely discolored, Green Mountains the least, with Cobblers and Katahdins intermediate. There was no correlation between the amount of discoloration and the rate of kill. Cyanamid Aerodefoliant which gives a very slow stem kill gave the most discoloration while Sinox, a material which gave an intermediate to a slow rate of kill, gave the least discoloration. Lotemcide which gave an exceptionally fast rate of kill produced less discoloration than Dow 66 which gave a fast to intermediate rate of kill. It may be that factors other than materials are more important in producing the vascular discoloration. Factors possibly contributing to the amount of the discoloration are variety, maturity of the vines, soil temperature and moisture and possibly air temperature and humidity the days following the application of the top killer.

Experiments during the winter of 1947 showed that the vascular discoloration could be produced under greenhouse conditions using Sinox without an activator. The discoloration was found to be only in the vessels and limited to the cell contents. In less severe cases not all vessels in a bundle had their contents discolored. In some specimens the discolored contents of the vessels were more dense on the stem-end side of the vessel end walls. No discoloration produced by top killing has been observed in tissues other

than the vessels of the xylem. These observations were checked and substantiated many times following field experiments during the summer and fall of 1947.

To check on the effect of storage on discoloration, potatoes were placed under ordinary storage conditions and samples were cut December 19, 20, and 21, and March 23, 24, and 25. A considerable part of the discoloration observed at harvest time had faded when the potatoes were cut in December, and was nearly all gone in March.

Minute traces of arsenic were found in tubers which had been top killed with arsenical compounds and also in tubers which had not been treated with arsenical top killers. The amount of arsenic present seemed to be correlated with the amount they received in the top-killing material. The amount of AS_2O_3 varied from less than 0.003 to 0.136 ppm for tubers treated with arsenical top killer in contrast with less than 0.003 for the untreated plots.

USE OF INSECTICIDES TO CONTROL APHIDS. W. A. Shands,[6] G. W. Simpson. The use of DDT increased the yield of potatoes due to an increase in the size of the tubers rather than to an increase in the number of tubers set on the plants. The increase in the number of tubers making U. S. #1 grade and in the average weight per tuber was determined by harvesting plots of Green Mountains at 6 different dates. The effect of the DDT on potato yields appears to be the result of reducing to a minimum the plant injury caused by insects. The use of DDT materially reduces the number of aphids on potatoes; it delays the development of the peak population; and it reduces the number of winged aphids produced.

A comparison of 5 different solvents used in commercial DDT emulsions indicated some difference in aphid control but had no significant influence on yield. The addition of parathion or pyrethrum to DDT gave increased control of aphids when compared to DDT alone. The addition of a non-volatile oil to DDT dust also increased the effectiveness of the dust.

Growers are interested in discontinuing applications of DDT as soon as feasible during the growing season. Among the reasons for this is the fear that DDT residues accumulating in the soil may become toxic to plant growth. During 1947 the use of DDT

[6] Cooperative study with Bureau of Entomology and Plant Quarantine, U. S. Dept. Agr.

dust after the last of July did not increase yield significantly due, in part, to the fact that plants were not reinfested by aphids flying from weeds, as is usually the case. DDT applied as a spray after July resulted in increased yield. Evidently the DDT dust held the aphids to a lower number, while the sprays merely held the aphid populations in check until the sprays were discontinued, after which the aphids increased in the normal manner.

SOME REASONS WHY LEAFROLL DID NOT SPREAD EXTENSIVELY IN 1947. W. A. Shands,[7] G. W. Simpson. The increased abundance of seed stocks tested in Florida that were low in virus diseases was due in large measure to the high quality of seed stocks planted and the scarcity of aphids during the 1947 field season. Seed stocks planted in 1947 were generally more nearly free of leafroll than those planted for several years, consequently the chances were less than usual for aphids feeding on the developing plants to acquire the leafroll virus.

Observations of aphid populations developing on wild plum before and during the period of spring migration showed that colonies of the green peach aphid were not generally abundant in 1947 and that they contained fewer aphids per colony than in several previous years. Also, weather was unfavorable for flight from the plums on several occasions during the period of migration. Because of the late spring, development of wild plums was considerably retarded, and the spring migration of the green peach aphid began later than at any time in the years for which records are available.

In contrast with this condition, planting of potatoes in the area took place at about the usual time. Under these conditions it appeared that many of the spring migrants went directly to potatoes rather than to intermediate weed hosts as happens when migration occurs earlier in the year before potatoes are up.

Weed hosts growing in wasteland and in other places usually serve throughout much of the summer as a constant source of winged green peach aphids to infest potatoes. They were of much less importance in this respect in 1947 as shown by the indexes of total seasonal productiveness of the green peach aphid on 5 species of weeds growing in wasteland in 1947. These indexes, expressed as percentages based on the 1946 production, are as follows:

[7] Same as footnote 6.

Species of weed		Per cent as productive in 1947	
		Wingless forms	Winged forms
Wild rutabaga	(Brassica campestris L.)	4.4	2.0
Wild radish	(Raphanus raphanistrum L.)	6.1	3.1
Lamb's-quarters	(Chenopodium album L.)	0.9	1.9
Smartweed	(Polygonum lapathifolium L.)	6.1	6.2
Hemp nettle	(Galeopsis tetrahit L.)	8.3	3.0

The general use of DDT on potatoes in 1947 could have contributed to a decrease in the potential spread of leafroll. Its use reduced the number of winged green peach aphids that could mature on potatoes and, by flying, spread the disease from field to field. Experiments showed that by beginning applications of DDT early and by continuing them weekly, aphid populations on potatoes were kept small. When application was discontinued the population of the green peach aphid increased. However, the time when peak numbers developed was much later in the season than it was on untreated potatoes. Observations and counts showed that in 1947 the degree of aphid control achieved by growers applying DDT to potatoes varied from poor to excellent, but in most instances it was good.

Flying forms of the green peach aphid were not abundant until mid-September, which was too late to spread much leafroll because killing frost occurred soon after. Observations have shown that in seasons when leafroll spreads extensively, symptoms of current season spread are found early in August.

Obviously the spread of leafroll will be reduced when the numbers of the flying aphids are small, the flight occurs late, and aphicides are applied to potatoes. At present, however, there is no evidence to indicate that the use of aphicides on potatoes only can reduce the annual potential danger from aphids. For example, following the general use of DDT in 1946, populations of the potato aphid in 1947 on wild roses during the spring and on untreated potatoes during the summer were larger than those found in several years. The aphid eggs on wild plums in the fall of 1947, were as numerous as they were at the same time the preceding year and were present in a larger percentage of thickets. This would indicate that the green peach aphid was successful in establishing fall colonies on wild plum despite the aphid control on potatoes achieved

during 2 successive years by the use of DDT and despite the low populations of the green peach aphid found developing on weeds in 1947.

FLORIDA TEST 1947-1948. G. W. Simpson, W. F. Porter,[8] E. L. Newdick.[8] The test this year for leafroll and other virus diseases was conducted under adverse conditions because of a high-water table. This situation delayed planting and reading and caused some loss of plants in low areas. However, the results, as shown below, were very satisfactory. There appears to be an abundance of good seed for planting in 1948.

One sample of Kennebec was of particular interest in that it did not show any injury from blight although other varieties were severely injured before the test was completed.

It should be noted that the tolerance for foundation seed was changed from 2 per cent of leafroll to 1 per cent total virus this year.

The tabulation below gives in detail the results of the test.

Variety	No. of samples	Approx. total acreage	Foundation seed[9] Per cent	Table stock seed[10] Per cent	Not recommended for seed[11] Per cent
Bliss	7	104	78	22	0
Irish Cobbler	228	2500	90	9	1
Chippewa	432	4891	71	24	5
Green Mountain	215	2464	66	32	2
Houma	9	102	73	27	0
Katahdin	572	6656	88	12	0
Mohawk	11	47	83	17	0
Pontiac	7	25	100	0	0
Russet	3	20	55	45	0
Sebago	66	470	86	9	5
Sequoia	4	36	72	0	28
Teton	1	0.3	0	100	0
All varieties	1555	17315.3	80	18	2

DISSEMINATION OF POTATO VIRUS DISEASES. Reiner Bonde, G. W. Simpson. Certain common weeds as the wild mustards, wild radish, and lamb's-quarters do not harbor the leafroll virus, although these plants serve as breeding hosts for the potato aphids. Infested potato plants in the farmers' fields appear to be the chief source of leafroll spread.

Studies with the wild ground cherry, *Physalis angulata,* con-

[8] Cooperative project with Division of Plant Industry, Maine Dept. Agr.

[9] Total virus 1% or less.

[10] Total virus 1.1% to 5%.

[11] Total virus 5.1 or over (as high as 19.8% in some cases).

firmed the results that the peach aphid is the chief vector of leafroll. The other aphids found feeding on potatoes did not spread the leafroll disease readily.

Only about 1 aphid per 1000 of the winged dispersal form of aphids carried the leafroll virus. However, when the flight of aphids is large, a considerable amount of disease spread may occur.

SPRAY AND DUSTING EXPERIMENTS TO CONTROL POTATO BLIGHT. ***Use of DDT.*** Reiner Bonde, James Robinson,[12] Roland Powers. The addition of DDT as an oil emulsion or a wettable powder, when combined with Dithane, basic copper sulphate and Bordeaux mixture, delayed the appearance of late blight and improved the disease control early in the season. However, the addition of DDT did not appear to improve the fungicidal value of the fungicides toward the end of the season when the spread of the disease became very rapid.

Two DDT oil emulsions in combination with tribasic copper sulphate were found to differ greatly regarding their toxicity to potato foliage. One material did not cause foliage injury when used at the rate of 8 quarts per 100 gallons of spray mixture or 8 times the recommended strength. The other emulsion injured the potato foliage when used at greater concentrations than 1 quart per 100 gallons of spray mixture. Both of the DDT emulsions were compatible with basic copper sulphate and good control of late blight, early blight and the insects was secured.

The yield rate was decreased as the amount of 25 per cent DDT oil emulsion in the spray mixture was decreased from 1 quart to ½ pint per 100 gallons of spray mixture. The degree of early blight increased from 51 per cent to 64 per cent with this decrease in DDT as the amount of DDT was decreased from 1 quart per 100 gallons to ½ pint per 100 gallons. Approximately 84 per cent of the potato foliage was destroyed by early blight in the plots which did not receive applications of DDT with a fungicide.

Comparison of Different Fungicides. Reiner Bonde, James Robinson, Roland Powers. The 3 highest yield rates, in an experiment comparing 8 different fungicides combined with DDT, were secured with the organic fungicides Parzate, Zerlate and Dithane. The yields were 218, 218 and 216 barrels respectively compared with 192 barrels for Bordeaux. These new fungicides, however, did not control late blight as well as did Bordeaux. Parzate was superior

[12] Employed cooperatively by Sherwin-Williams Co.

for the control of early blight. The copper fungicide COCS also produced yields that were superior to those with Bordeaux and the control of late blight was fairly good. All of the fungicides were compatible with DDT and gave good control of aphids and flea beetles.

Three newly developed zinc and copper organic fungicides possessed considerable fungicidal properties, but were inferior to basic copper sulphate and Bordeaux mixture. The 2 copper-containing organic fungicides (copper nitro dithioacetate and copper nitroacetate) controlled late blight better than did the zinc fungicide, zinc nitro dithioacetate. There was some indication that a combination of zinc nitro dithioacetate and copper nitro dithioacetate as a spray material had a stimulatory effect on the growth of the potato. (In another experiment certain zinc-containing fungicides yielded significantly more than those which did not contain zinc.) The yield rates for these fungicides, when combined with benzene hexachloride, were less than they were for the same fungicides combined with DDT.

In another experiment, a copper-containing material derived as a by-product from an industrial plant was proved to be a promising fungicide for the control of late blight, and was compatible with DDT.

The amount of early blight was considerably less in the plots sprayed with Bordeaux than in those sprayed with basic copper sulphate.

Effect of Adding Sulphur and Other Materials. Reiner Bonde, James Robinson, Roland Powers. Sulphur when added to the spray fungicides did not increase the yield rate or the control of the diseases and insects. Chlorinated camphene (Toxaphene) and hexaethyl tetraphosphate likewise did not improve the fungicidal and insecticidal value of the spray materials in these experiments. The latter product reduced the yield rate 31 to 35 barrels per acre when used at the rate ¼ and ½ pint per 100 gallons of spray material.

Effect of Adding Different Amounts of Lime in Bordeaux Mixture. Reiner Bonde, James Robinson, Roland Powers. Increasing the amount of lime in the Bordeaux formula did not affect late blight but reduced the amount of early blight infection. This might account for the fact that high-lime Bordeaux (8-16-100) yielded 9.3 barrels more per acre than did the low-lime Bordeaux

plots. This is contrary to the results of the 1946 experiment, and indicates the importance of conducting an experiment for more than 1 year before definite conclusions are made.

The addition of 4 pounds of lime to 100 gallons of basic copper sulphate spray mixture reduced the amount of early blight infection, reduced the damage caused by flea beetles, and increased the yield rate 32.2 barrels per acre.

Use of Dust Fungicides. Reiner Bonde, G. W. Simpson. The data secured in these experiments showed that good control of late blight can be secured with neutral copper-talc dusts containing 4.1 or 5.0 per cent metallic copper applied at the rate of 40 pounds per acre. Previous recommendations were to use 7 per cent metallic copper. More frequent applications of the low-copper dusts made at the critical periods may give better disease control than fewer applications of dusts containing more metallic copper.

Previous experiments have shown that the yield rate of fields dusted with copper-lime dust fungicides containing DDT was inferior to those secured with the dusts containing talc and a neutral copper. This reduction in the yield rate has been attributed to the fact that DDT is not compatible with the lime contained in the copper-lime fungicide which resulted in poor control of the diseases and insects. An experiment conducted in 1947 showed that newly mixed copper-lime dust fungicide containing DDT controlled both early and late blight better than did the same kind of dust which was not used soon after being prepared. The ability to reduce the number of aphids and flea beetle injury also was greatly increased when the newly mixed fungicide was used. The plots to which the newly mixed copper-lime dust had been applied gave the best yields, namely, 212 barrels per acre compared with 196 barrels per acre for the old mix copper-lime dust, and 199 barrels per acre for the neutral copper and talc dust.

Dusting with Helicopter for the Control of Late Blight. Reiner Bonde, Milton Adelman.[13] A helicopter was used for applying dust fungicides to a number of potato fields in Aroostook County. The preliminary tests showed that the late blight disease can be controlled by applying fungicides with this kind of equipment.

The helicopter is very maneuverable and it was possible to secure good coverage of the foliage even at the ends and sides of the fields and in those places obstructed by trees and other objects.

[13] Cooperative study with Maine Potato Growers, Inc.

The chief objection to the use of the helicopter for making the dust applications is the relatively high cost to the farmer. One of the chief advantages of using the helicopter duster is that the loss in yield from wheel injury by the sprayer or dusting equipment is eliminated.

Loss in Yield from Injury by Wheels of Spraying and Dusting Equipment. Reiner Bonde. The reduction in yield in the rows injured by the sprayer wheels varied from 17.1 to 27.9 barrels per acre, the average being 21.8 barrels. The reduction in yield on the basis of the whole field averaged 10.9 barrels. The percentage loss for the whole crop varied from 5.1 to 7.5 per cent, or an average loss of 6.4 per cent.

The average loss per acre with a 6-row boom was 14.6 barrels as compared with a loss of 11.0 barrels for an 8-row boom and a loss of 8.7 barrels for a 10-row boom. The corresponding percentage crop loss for the different length booms was 8.6, 6.4, and 5.1 per cent respectively. In terms of money, with potatoes selling for $4.00 per barrel, the loss per acre would be $58.40, $44.00 and $34.80 for the 6-, 8- and 10-row booms respectively.

A trailer type of duster drawn by tractor power reduced the yield in a field of Cobbler potatoes 6 to 11 barrels per acre, depending on the number of rows covered by the duster swath. A tractor-mounted duster on Katahdin potatoes reduced the yield rate 5 to 8 barrels per acre.

DISINFECTANTS FOR CONTROL OF RING ROT. Reiner Bonde, Donald Merriam. Most of the many disinfectants tested had little or no value for the control of ring rot. The numerous advertised "Quarternary Ammonium" compounds have not given satisfactory control of the ring rot disease in tests conducted at Aroostook Farm. The following materials appear to possess good disinfecting properties when used to treat contaminated wooden surfaces:

Aczol Wood preservative (1 part in 10 parts water).
Coal Tar Dip (1 to 2 gallons per 100 gallons water).
S.C.S. #369 Emulsion, an experimental product (1 part in 25 gallons water).
Puratized N-5-E and #806 (2 pints in 100 gallons water).
Corrosive sublimate (3 ounces in 12 gallons water).
Copper Sulphate (2 pounds in 10 gallons water).

Copper Sulphate and table salt, but these products were corrosive on metal parts of machinery and equipment.

Corrosive sublimate and the Puratized compounds are the only disinfectants that destroyed the ring-rot bacteria on cut seed potatoes. Both of these materials, however, were toxic to the cut surfaces of the potatoes and caused considerable injury.

A number of disinfectants were tested regarding their possible value for the sterilization of contaminated cutting knives. Corrosive sublimate (2-1000 with an acid) was the only material which gave good control of ring rot. Copper Sulphate (4 pounds in 10 gallons water) and "Roccal" (1-500) were promising disinfectants but did not give complete control of the disease resulting from dissemination by the cutting knife.

PURPLE TOP AND ITS CONTROL. Reiner Bonde. The purple top disease was not prevalent in the potato crop in 1947 and it was not possible to study the development and spread of this disease in the field. The small amount of purple top (both in 1946 and 1947) may have been due to the fact that many farmers used DDT which destroyed the six-spotted leaf hopper considered by some workers to be the vector of this disease. Aster yellows, said to be the virus causing purple top, was prevalent in weeds in the vicinity of Aroostook Farm.

An attempt to produce purple top by means of inoculations in the greenhouse using the six-spotted leaf hopper has been unsuccessful.

MILD SEED TREATMENT FOR CONTROL OF SEED-PIECE DECAY. Reiner Bonde, Donald Merriam. Treating seed potatoes for the control of rhizoctonia, blackleg, and seed-piece decay has been discontinued by many farmers in Maine. One reason for this is the fact that the old mercury dipping methods often caused severe injury to the seed stocks of the new varieties which resulted in reduced yield rates.

Recent experiments indicate that sodium hypochlorite (Chlorox and similar materials used at rate of 1 gallon in 50 gallons water), Dithane D14 (used 1 part in 200) and a number of Quarternary Ammonium compounds greatly reduced the amount of seed piece decay caused by bacteria and fungi and increased the yield rate.

DEVELOPMENT OF NEW POTATO VARIETIES. ***Resistance to Field Spread of Leafroll.*** Donald Folsom. Additional potato seedling varieties were found that were resistant to field spread of leafroll from adjacent Chippewas. These were from seedling varieties introduced to the test at Highmoor Farm in southwestern Maine

in 1946, symptoms of the disease showing in 1947. Of 1934 introduced, nearly half became leafroll and about as many more were discarded in 1946 and 1947 for poor vine and tuber type, leaving 141 for further testing. Two resistant seedlings crossed with the same variety did not transmit resistance similarly. About 70 field-resistant seedling varieties with acceptable vine, tuber, and cooking characteristics, from crosses introduced to the Highmoor Farm test 1942-44, were tested for yield rate on Aroostook Farm. Of these, several appeared worth further testing. Here inherent differences in number of stems per hill affected tuber size and yield rate. Some leafroll-resistant seedlings seem to show field resistance to virus X in common with certain parents. One leafroll-resistant seedling of a Katahdin-Houma cross is in demand in some northeastern States as a possible substitute for Chippewa.

Resistance to Aphid Inoculation of Leafroll. Reiner Bonde, G. W. Simpson. A number of commercial and selected seedling varieties were compared regarding their relative susceptibility to leafroll infection when inoculated with viruliferous aphids. Some of the selected seedlings were very resistant to leafroll infection, with only 17 to 25 per cent of the inoculated plants becoming infected. In contrast, the Teton, Green Mountain, Chippewa, Warba and Sebago varieties were very susceptible, with 96 to 100 per cent of the inoculated plants becoming infected. The Houma, and Katahdin varieties showed some resistance to infection, but 80 and 84 per cent respectively of the inoculated plants developed the leafroll disease.

Resistance to Ring Rot and Late Blight. Reiner Bonde. Donald Merriam. Testing newly developed potato seedlings of different progenies was continued in 1947. Several very promising ring rot resistant seedlings were selected, which possess desirable foliage characteristics, attractive tubers, and high yielding ability. Two of these new seedlings are practically immune to the common strain of late blight, both in the foliage and tubers besides possessing ring rot resistance.

The reaction of 8 named and 3 numbered varieties was studied regarding their reaction to ring rot when inoculated by artificial means. The Teton variety and seedling 336-144, resistant varieties, again were free from ring rot. Erie, a variety related to Teton, showed 40 per cent ring rot. In contrast with these, Katahdin, Earlaine, 96-44, Hindenburg and B287-2 were 100 per cent infected.

DEVELOPMENT OF DISEASE-FREE SEED POTATOES AND EFFECT ON YIELDS. Reiner Bonde, Donald Merriam. Seed stocks of seed potatoes are being developed by the Maine Experiment Station which are relatively free of the latent mosaic and the other tuber-borne diseases. These high yielding seed stocks will be made available to the Maine Seed Potato Board for increased production and distribution to farmers who are in need of new seed stocks. Yield tests in 1947 showed that Katahdin seed potatoes having a high percentage of latent mosaic, yielded 172 barrels per acre compared with 194 barrels per acre for the same variety which did not have latent mosaic. A strain of Sebago seed potatoes, having latent mosaic, yielded at the rate of 159 barrels per acre compared with 172 barrels per acre for the seed stock which was free of this disease.

Approximately 12,000 seed tubers were increased in the greenhouse for the purpose of securing ring rot-free seed stocks. A large number of samples of farmers' and dealers' seed potatoes also were examined for ring rot this past year. These samples represent a large percentage of the seed potatoes that will be planted in Maine. Checking these samples should help to reduce the amount of infected seed stocks that will be planted.

POTATO TUBER DISEASES IN STORAGE AND TRANSIT. Donald Folsom. From potato tubers with a reddish discoloration of the xylem and a corrosion at the stolon scar, bacteria were isolated that also produced a shallow black rot of seed pieces.

In shipments from Maine to New York City, stem-end browning was found to increase significantly in transit at 43 to 50° F. and subsequently to decrease in storage at about 65° F.

POTATO VARIETY TESTING. W. C. Libby, R. V. Akeley,[14] G. W. Simpson, D. Folsom, R. Bonde. Fourteen different varieties of potatoes were grown at four different locations within Maine to measure yield response under different environmental conditions. The yield and specific gravity by varieties at each location were as follows:

[14] Cooperative project with Bureau of Plant Industry, U. S. Dept. Agr.

Variety	Van Buren		Presque Isle		Patten		Old Town	
	Specific Gravity[15]	Yield per Acre	Specific Gravity[15]	Yield per Acre	Specific Gravity[15]	Yield per Acre	Specific Gravity[15]	Yield per Acre
		Bu.		Bu.		Bu.		Bu.
Kennebec (B70-5)	1.0726	664	1.0824	593	1.0743	822	1.0828	619
Green Mountain	1.0772	657	1.0909	565	1.0785	604	1.0892	585
Teton	1.0706	652	1.0805	537	1.0693	670	1.0787	529
Ontario	1.0671	616	1.0777	549	1.0683	666	1.0771	452
B69-16	1.0755	584	1.0838	519	1.0741	800	1.0860	505
N.D. K-5	1.0629	576	1.0699	574	1.0610	689	1.0724	485
Chippewa	1.0649	570	1.0728	572	1.0664	596	1.0728	495
Mohawk	1.0782	540	1.0862	491	1.0789	599	1.0892	539
Katahdin	1.0726	538	1.0705	510	1.0687	583	1.0783	451
Irish Cobbler	1.0754	530	1.0837	535	1.0757	620	1.0803	470
B61-3	1.0752	528	1.0837	511	1.0776	674	1.0860	558
1276-185	1.0716	511	1.0760	479	1.0662	492	1.0765	428
Sebago	1.0702	502	1.0790	472	1.0712	533	1.0796	503
46952	1.0597	349	1.0637	351	1.0594	522	1.0680	383
N.D. 2-23	—	—	1.0752	503	—	—		

POTASH SOURCE EXPERIMENTS. G. L. Terman, Arthur Hawkins,[16] and S. C. Junkins. The potash sources used in this study were muriate or chloride (KCl), and sulfate (K_2SO_4). In 5 tests with the Katahdin variety, the differences in yield of potatoes for the 2 sources were small and not significant. In one test with the Green Mountain variety, however, sulfate produced a significant increase in yield of 34 bushels over the chloride source of potash. Thus there appears to be a varietal difference as to the response to the chloride and sulfate sources.

As to quality of the tubers, the sulfate source of potash produced a consistently higher content of starch, as indicated by specific gravity determinations, than did chloride. This difference averaged one per cent in starch content, or an increase from 13.5 to 14.5 per cent. Chemical tests for soluble nutrients in fresh rachis portions of the green potato vines showed that the plants fertilized with muriate had a considerably higher chloride content, and a somewhat lower content of nitrogen, magnesium, and dry matter. There appears to be a fairly close inverse relationship between the content of chloride in the plant and the starch content of the tubers.

[15] Specific gravity gives an indication of quality. The higher the specific gravity the higher the quality. A specific gravity of 1.078 indicates a starch content of about 13.5 per cent. An increase of .005 in specific gravity is equivalent to an increase of 1 per cent in starch.

[16] Associate Soil Scientist, working in cooperation with the Soil Phosphorus Section, Div. Soil Management and Irrigation, U. S. Dept. Agr., and the Maine Agr. Exp. Sta.

Radioactive Phosphorus Fertilizer Tests. Arthur Hawkins.[16] Radioactive isotopes offer a means of determining what proportion of an element absorbed by plants is taken from the applied fertilizer as compared to that taken from residues in the soil. The location and movement of a radioactive material in the plant also can be traced by the use of special instruments or photographic methods.

Radioactive phosphorus at the rates of 40 and 120 pounds of P_2O_5 per acre was added to the fertilizer applied to potatoes at 3 locations in Aroostook County. Samples of the potato plants, taken at early bud stage, full bloom, and 5 weeks later, were analyzed for total and radioactive phosphorus.

Results from the experiment indicate that the potatoes take a larger amount of phosphorus from the fertilizer as the amount of phosphorus in the fertilizer is increased. On a soil low in readily soluble phosphorus, 26.7 per cent of the total phosphorus in the plants at the final sampling date had been absorbed from the fertilizer with the smaller application of P_2O_5, as compared to 51.5 per cent from the larger application. The corresponding figures for soils with a medium phosphorus content were 13 per cent for the smaller application versus 26 per cent for the larger application. On the soils medium in phosphorus content, only 9 per cent of the phosphorus applied at the 120 pound rate was used by the potatoes. A comparable figure for potatoes grown on soil low in phosphorus was 25 per cent of the 120 pounds of P_2O_5 applied.

At earlier sampling dates potatoes had obtained a higher proportion of their phosphorus from the fertilizer than at the later date. This indicates that potatoes may be largely dependent upon the applied fertilizer early in the season. As the season progresses, the crop is able to obtain an increasingly large proportion of its phosphorus needs from the soil.

Phosphorus Placement Tests. Arthur Hawkins,[17] G. L. Terman and S. C. Junkins. Placement tests were conducted on potatoes at 4 locations near Presque Isle. The regular placement of the phosphorus as triple superphosphate in row side bands with the nitrogen and potash fertilizer was compared with placing only the phosphate nearer the seed pieces in bands about 4 inches wide. Since greenhouse tests showed that freshly cut seed was injured

[17] Same as footnote 16.

when planted in direct contact with superphosphate, about one-fourth inch of soil was placed either on top of the band of phosphate before the seed was planted, or on the planted seed pieces before the band was applied.

At 3 locations having soils low to medium in readily soluble phosphorus, yields of Katahdin potatoes were appreciably lower when the 80 pounds P_2O_5 per acre was applied with the seed rather than applied in side bands. At the fourth location on a soil high in phosphorus, the 2 methods of application produced the same yield. In 3 out of 4 tests, application of 80 pounds P_2O_5 with the seed and an additional 80 pounds in side bands resulted in slight but not significant increases in yield over applying 160 pounds P_2O_5 in side bands. In general, the application of all of the phosphate in side bands in the usual manner was slightly better than applying part or all of it with the seed.

LIMING AND RATE OF PHOSPHORUS TESTS. Arthur Hawkins,[18] G. L. Terman, and S. C. Junkins. These tests were conducted at 2 locations near Presque Isle for the purpose of determining the possible effect of liming acid soils on the efficiency of the phosphorus applied in the fertilizer. Ground limestone was broadcast on the 2 soils, having pH values of 4.3 and 5.0, at the rate of 3000 pounds per acre and harrowed in prior to planting potatoes. Phosphorus was applied at the rates of 0, 60, 120, 180, and 240 pounds P_2O_5 per acre on different plots, all of which received nitrogen and potash equivalent to 2000 pounds of 6-0-10. Liming did not increase the efficiency of the phosphorus applied in the fertilizer, nor were potato yields higher on the limed plots than where lime was not applied. No potato scab was found on tubers from the limed plots.

At one location on a soil low in phosphorus, yield increases were obtained for all rates of P_2O_5 compared, although increases for the higher rates were not significant. At the other location on a soil medium in phosphorus, the yields increased only up to 180 pounds P_2O_5.

NITROGEN RATE EXPERIMENTS. G. L. Terman, Arthur Hawkins,[18] S. C. Junkins, Michael Goven. Six field experiments were conducted comparing different rates of nitrogen for potatoes. The fertilizer mixtures were applied at the rate of 2000 pounds per acre with the nitrogen rates consisting of 90 pounds (4½-9-9), 120

[18] Same as footnote 16.

pounds (6-9-9) and 150 pounds (7½-9-9). All the fertilizer was applied in row side-bands at planting in the usual manner.

Yields of potatoes were the same for the 3 nitrogen rates for 2 tests with the Katahdin variety following clover the previous year. In 3 tests with the Katahdin variety following potatoes the previous 2 or 3 years, however, significant increases in yield resulted from the 120 pound nitrogen rate over 90 pounds. Further increases were obtained from 150 pounds of nitrogen over 120 pounds, although these increases were not significant. In one test with the Green Mountain variety following clover, a decrease in yield resulted from both the 120 and 150 pound rates, as compared to 90 pounds. These tests indicate a varietal difference of potatoes as to their response to nitrogen fertilization, as well as a difference due to the cropping practice.

In tests previous to 1947, little or no increase in yields was obtained for more than 80 to 100 pounds of nitrogen for potatoes following clover or 120 pounds following potatoes the previous year. With better control of insects and diseases, the tubers continue to develop for a longer time and more nitrogen may be used.

RESPONSE OF POTATOES TO ZINC. G. L. Terman and Arthur Hawkins.[18] Fertilizer containing none or only trace amounts of zinc was compared in 4 experiments with fertilizer containing 20 pounds of zinc sulfate per acre. In 2 of the tests potatoes yielded the same, whether fertilized with zinc sulfate or not. In the other 2 tests zinc sulfate increased the yield by 12 bushels per acre in both tests. In one of these tests, zinc increased yields an average of 32 bushels on the plots cropped every year to potatoes, 11 bushels on plots where potatoes are grown in alternate years with crimson clover and only 2 bushels on plots in a similar rotation with millet. These results indicate that zinc may be more deficient in some soils cropped every year or frequently to potatoes than where a rotation is practiced and adequate amounts of organic matter are returned to the soil. The yield responses to zinc in the fertilizer may possibly explain some of the higher yields obtained with dithane and other fungicides containing zinc sulfate, as compared to others containing no zinc.

POTATO SOIL FERTILITY EXPERIMENTS IN CENTRAL MAINE. G. L. Terman. Field experiments on potato soil fertility problems were begun in Central Maine in 1947 including a sandy soil at Milo and a Bangor loam soil at Unity. The development and con-

trol of potato scab is to be studied on various plots where the soil is being adjusted to different pH levels by liming and the application of an acidifying material such as ammonium sulfate. A comparison also is being made of growing potatoes every year on certain plots in contrast with potatoes grown in a 2-year rotation with millet and clover.

Extra nitrogen broadcast, in addition to 2100 pounds of 5-10-10 applied in row side bands, slightly increased potato yields at Unity but had no consistent effect at Milo.

Yields of various nonlegume green manure crops grown at Unity were markedly increased by fertilization with ammonium nitrate at rates of 50 and 100 pounds of nitrogen per acre. Millet, field corn, sunflowers, and oats all produced 3 to 4 tons of dry matter per acre when fertilized with nitrogen.

APPLYING MULCH FOR POTATOES. G. L. Terman, W. C. Libby, S. C. Junkins. Light mulching of the land after potatoes are planted, using mulch material grown elsewhere, offers a means of maintaining the soil organic matter so that potatoes can be grown every year on the better, more level land. The mulch crop could be grown on the poorer, more sloping land and applied on the potato land, providing that a feasible means of harvesting and spreading the material can be devised. The need for cultivating the mulched land may be eliminated by chemical control of weeds.

In one test unchopped green grass and green clover mulches, spread at the rates of 5 and 3 tons of dry matter per acre respectively, and applied when the plants were emerging, increased the yield of potatoes slightly. Covering the soil with heavy paper or sawdust, however, decreased the yield 80 to 90 bushels per acre, or a decrease of about 16 per cent. The latter materials apparently reduced the amount of moisture entering the soil from rain, so that the soil on these plots was much drier than on the others at time of harvest.

In a second test partly rotted straw, unchopped green grass and unchopped clover mulches, applied after potatoes had been ridged once by cultivation, all increased the yield appreciably. Sawdust again decreased the yield. Extra nitrogen fertilizer broadcast with the mulch at the rate of 60 pounds N per acre further increased the yield of potatoes mulched with green grass but not of those mulched with green clover. Observations at time of harvest indi-

cated that chopping the materials would be necessary to prevent trouble during digging.

Irrigation of Potatoes. R. A. Struchtemeyer, W. C. Libby. The effect of irrigation on Katahdin potato yield was studied on a fine sandy loam in Maxfield in Penobscot County. Moisture records were kept by means of gypsum blocks buried 6 inches below the surface of the soil. Although the plants were killed by late blight in the early part of September an increase of 15 barrels per acre was obtained by irrigation. The average yield was 141 barrels for the irrigated plots and 126 barrels for the non-irrigated plots. A supplemental addition of 50 pounds of nitrogen per acre in the irrigation water produced an additional increase of 10 barrels per acre.

Greensprouting and Thiourea Treatment. P. J. Eastman, W. C. Libby. Plants from greensprouted seed emerged 5 to 6 days before those from the unsprouted seed and retained this advanced development through the first 2 months of the growing season. At harvest dates in August, the greensprouted seed produced larger yields in all varieties. Greensprouting had little effect on yield from plots harvested September 10 when all tops had been killed by frost. The larger yield produced from the greensprouted seed was caused by a general increase in tuber size.

The treatment of seed potatoes with thiourea (1 hour soak in 1 per cent solution) resulted in significant increases in number of stems per hill, number of tubers per hill, and yield of tubers 1½ to 2½ inches in diameter. The treatment also caused slight increases in total yield especially in the Katahdin variety. In general, the yield of tubers over 2½ inches in diameter was less from the treated seed than from the untreated seed.

The results of this study indicate that a combination of greensprouting and thiourea treatment would be practical for seed plots to be early harvested. For commercial seed growers, the thiourea treatment alone would be a practical way to obtain larger yields of tubers in the size range desirable for seed.

Chemical Weed Control in Oats, Peas, and Japanese Millet in the Potato Rotation. P. H. Plaisted. For oats, the ammonium and sodium salts of 2,4-D applied at dilutions of 500 ppm and a rate of 100 gallons of spray material per acre killed common annual weeds such as mustard, kale, lamb's-quarters, spurry, and hemp nettle if applied when the oats were less than 6 inches tall. While young clover plants were reduced in number, there were

approximately 100 clover plants per square yard at harvest time. The ammonium, morpholine, and sodium salts and the butyl ester formulations of 2,4-D in dilutions of 1000 ppm applied at the same rate from seeding to the milk stage did not injure the viability of the mature grains of Maine 340 oats.

For peas, Dow Selective at dilutions of 2¼ to 3 pints plus 2 pounds of ammonium sulfate in 100 gallons of water per acre applied at the 2 to 4 leaf stage killed weeds without reducing the yield of peas. Sinox-W at ¾ to 1 gallon in 100 gallons of water per acre also killed weeds without reducing the yield of peas. Sodium chloride used at concentrations of 15, 20, and 25 per cent in water did not kill weeds in peas, nor injure the peas. Copper sulfate applied in a 5 per cent concentration in water damaged peas and did not control the weeds.

The triethanolamine salt of 2,4-D controlled weeds at dilutions of either 500, 1000, or 1500 ppm at 100 gallons per acre without reducing the dry matter yield of the Japanese millet.

SOIL CONSERVATION AND DEVELOPMENT OF NEW EQUIPMENT. J. W. Slosser,[19] G. L. Terman, W. C. Libby. The soil conservation demonstration farm in Ft. Fairfield was operated again during the year of 1947-48. During the year exploratory work was initiated on the construction of conservation structures to handle water disposal from field snow melt.

The primary engineering work was the design and construction of a 2-row potato harvester which was tested during the fall of 1947, and is serving as a basis for further developmental work on both single and 2-row potato harvesters. Work was also continued on the design and testing of spray nozzles for applying fungicides, insecticides and top-killers.

NEW EXPERIMENTAL POTATO STORAGE HOUSE. Howard Bartlett. An experimental potato storage house for Aroostook Farm has been designed and will be built during the summer of 1948. This storage house will serve as a laboratory for the dual purpose of studying methods of handling, grading and packaging potatoes and for controlling storage conditions as affecting quality of potatoes.

RECOVERY OF STARCH PLANT POTATO POMACE. M. E. Highlands, B. E. Plummer, Jr. Some success in dewatering potato starch plant pomace has been obtained using a wet lap paper machine.

[19] Cooperative study with Soil Conservation Service, U. S. Dept. Agr.

Approximately 13 per cent water can be removed. The resulting material has been dried in a tunnel-type drier.

It is hoped that the dried pomace may lend itself to the production of poultry and cattle feed. However, additional protein must be added to make a balanced ration. Feeding tests with poultry are being made. Drying equipment also might be used for producing clover meal which might serve as a supplement to dried pomace for developing dairy and poultry rations.

A typical analysis of the dried pomace follows:

Moisture	6.19
Protein	5.57
Fat	.48
Fiber	11.07
Ash	1.75
N Free Extract (by difference)	74.94

POTATO HARVESTING METHODS IN MAINE. W. E. Schrumpf. The average rate of digging and barreling potatoes in 1946 and 1947 was 537 barrels per digger in a 9-hour day. The average cost was 30 cents per barrel. Potato bruising incurred by these operations averaged 11.4 per cent of all potatoes by weight made up of 2.0 per cent major and 9.4 per cent minor bruises. There was an average of 11 potato pickers per digger. Important influencing factors include the type of machine, the digging pattern, the speed and agitation of apron, the number of potato pickers, potato maturity, soil moisture, weeds, stones, topography, and yield rate. Potato digger-picker combines observed have not been satisfactory under average Maine conditions although one or two show promise.

STORAGE, STORING, GRADING, AND PACKAGING MAINE POTATOES. C. H. Merchant, C. H. Keirstead, R. W. Brundage, W. E. Schrumpf. For the past 3 years information has been obtained on the time, equipment used, and the amount of bruising occurring in the storing of potatoes in farm and track storage houses. Considerable variation has been found in the efficiency in handling potatoes as well as wide differences in the amount of bruising taking place in storing potatoes.

Last summer about 50 potato storage houses located principally on farms were measured to ascertain the desirable and undesirable features of potato house construction as they affect the efficiency of

storing and taking potatoes out of storage along with the amount of damage occurring to the potatoes in the operations.

Information has been collected for the third consecutive year on taking potatoes out of storage. Time has been recorded on the various methods of handling potatoes along with the amount of bruising occurring.

Another phase of the project deals with the grading and packaging of potatoes as now conducted by shippers in Maine. This phase of the study includes both the wholesale and consumer packages of potatoes. Like other phases of the marketing work on this project this is the third year of the study. During this season more attention was given to the temporary storage of packaged potatoes and loading cars than during previous years.

The study of grading and packaging Maine potatoes as conducted in this project was closely associated with the study on wholesale and retail distribution of potatoes in the Portland market area.

WHOLESALE AND RETAIL DISTRIBUTION OF MAINE POTATOES. C. H. Merchant. One phase of consumer preference of potatoes was undertaken in the Portland market area during April and the first part of May, 1948, in conjunction with the preceding project. This phase of consumer preference deals only with the size of potatoes. The question is whether consumers prefer potatoes carefully sized or desire to buy potatoes consisting of mixed sizes. For this study 5½ carloads of potatoes were retailed through 10 super markets in the Portland market area in a 5-week period.

Shippers of Maine potatoes, transportation agencies, and retail stores in the Portland market area cooperated in this study. The potatoes supplied were of excellent quality and carefully sized and graded. The potatoes were offered to the public in 4 lots with tubers sized differently. One lot contained potatoes ranging in size from 1⅞″ to 2½″ in diameter. In another lot the potatoes were 2½″ to 3¼″ in diameter. The third lot contained potatoes ranging in size from 3¼″ to 4″ in diameter. There was 1 lot of potatoes which contained mixed sizes with the tubers ranging from 1⅞″ to 4″ in diameter. These potatoes were attractively displayed in retail stores and consumers' reactions were measured by their purchases.

The retail prices of these various lots of potatoes were changed during the five weeks of the study in an attempt to measure con-

FIG. 4. Display of Potatoes in a Super Market to Study Consumer Preference on Potato Sizes.

sumers' reaction. Careful records of potato sales were made available covering the periods before, during, and after the experiment. In addition to furnishing information on preference of size of tubers this study will furnish other information which should be of value in wholesale and retail distribution of Maine potatoes.

POTATO MARKETING PROBLEMS RESULTING FROM WAR. C. H. Merchant, H. C. Woodward. This regional project is in cooperation with the other experiment stations in the Northeast, Production and Marketing Administration, Bureau of Agricultural Economics, and the Plant Industry Division of the United States Department of Agriculture. Work on this project was begun late in 1947 with considerable time spent in the organization and the planning of the regional work.

A study of current and potential supplies of potatoes in the Northeast involves assembling statistical information on acreage and production of potatoes in the 12 Northeastern states before, during, and after World War II. Such information should show the shifts in production and indicate the general location of some future marketing problems.

An inventory of storage facilities includes information on frost-free-storage in all the important potato producing areas in the Northeast. This information may be collected for several years in order to indicate any changes or trends taking place.

Detailed information as to the utilization of late and intermediate crops of potatoes is being assembled for the past few years. Such information should show the maximum capacity for utilizing the potatoes and potato products as in 1943 and 1946, and also indicate the problems existing when there are insufficient supplies to maintain many of the potato product plants operating at capacity in low production years.

A complete inventory of all potato product plants in the Northeast area includes kinds, location, ownership, and capacity of plants and the quality and quantities of potatoes processed in each type of plant for the last 2 years. Also, information will be obtained on the sources of potato supplies and market outlets for products of each type of plant.

The field work for detailed analysis of the qualities of potatoes offered for sale in retail stores in Philadelphia, New York, and Boston has been completed. Potatoes were inspected to obtain

information on quality, including size of tubers, which are offered to the public for sale.

Information as to the deterioration and physical breakdown of potatoes in transit was collected through the cooperation of the Bureau of Plant Industry of the United States Department of Agriculture. The study included the development of net necrosis and mahogany browning in potatoes from shipping points in Aroostook County to terminal markets in New York City.

POULTRY

Effect of Different Feeding Methods with Pullets on Ladino Clover Range. J. R. Smyth, T. G. Culton. The results for this year are in close agreement with those reported for the previous year. Pullets on good ladino clover range will develop as satisfactory when fed a simplified ration, omitting the alfalfa, fish oil and fish meal, as those fed a complete growing ration. The pullets on good ladino clover range that were fed only ground grains, oyster shell flour and bone meal gained about one-third pound per bird less than those fed a complete ration. These pullets matured about 2 weeks later but soon caught up in weight and laid practically as well as the pullets fed a complete ration. Although a grain and mineral ration is not recommended for growing pullets, the results of this test demonstrate that ladino clover range will supply a large percentage of the protein and vitamin requirements of a growing pullet.

Breeding Barred Plymouth Rocks for Superior Meat Quality. C. E. Howes, J. R. Smyth. During the spring hatching season 77 females and 6 males were mated. These birds were selected on the basis of family records, individual acceptability along the lines of a desirable meat type of bird, egg production, and egg size and hatchability of dams. Two hatches involving 512 chicks were made. Weights were taken at 1 day, 2 and 8 weeks of age, and feathering observations at 2 and 8 weeks of age. Further observations of weight and body conformation will be made at the time the pullets are housed.

Length of Incubation Period in Poultry as Related to Characteristics of Progenies. J. R. Smyth, C. E. Howes. During the year the birds in 6 breeding pens were mated, including 3

pens composed of birds from the early hatching strain and 3 from the late hatching strain. Two hatches have been made involving 514 chicks. Observations were made every 4 hours, starting when the first chick hatched, to record the number that had hatched. All chicks were wing banded when removed from the incubator, weighed at 2 and 8 weeks of age, observed for rate of feathering, mortality recorded, and a record made of the sex. The pullets raised will be trapnested and records kept of age at first egg, egg production, and mortality.

The first chick hatched 19 days and 16 hours after the eggs were placed in the incubator. Twenty hours, or 4 observations later, 187 chicks had hatched from the 3 pens previously developed as early hatching birds. This was 76 per cent of all the chicks that hatched from these pens. During this same time only 14 chicks or 5.2 per cent of those that hatched from the late hatching pens had emerged from the shell. The first chick to hatch from the late hatching strain hatched 16 hours after the first 1 hatched from the early hatching strain.

NATURAL AND SYNTHETIC SUPPLEMENTATION OF CORN AND SOYBEAN OIL MEAL BREEDER DIETS. J. R. Smyth, S. B. Smith.[20] A study was made of the distribution of embryo mortality and of the malpositions of embryos dying from the eighteenth to the twenty-first days of incubation, inclusive. The chicks were reared to 2 weeks of age to check the mortality and gain in body weight during this period.

In the first experiment, the basal ration of corn, soybean oil meal, minerals, and crystalline vitamins was adequate for normal egg production, but was lacking in some factor (or factors) necessary for the production of hatchable eggs. This factor (or factors) was present in 5 per cent dried cow manure, in 5 per cent casein, and in 5 per cent alfalfa leaf meal. The various levels of niacinamide (400, 800, and 1200 milligrams) showed per 100 pounds no depressing effect on the hatchability, except when incorporated in a ration containing 5 per cent casein, when 1200 milligrams proved to have a toxic effect.

In the second experiment, all rations used were adequate for normal production and hatchability. The 5 per cent dried cow manure ration improved the hatchability above the other rations

[20] Graduate student, University of Maine.

which contained supplements of 3 per cent fish meal, 22 and 12 per cent protein rations including soybean oil meal, 5 per cent vitamin free casein, and 5 per cent straight casein. The basal diet consisted of corn, soybean oil meal, 2 per cent alfalfa leaf meal, 2 per cent 500 B.Y., and minerals.

A STUDY OF MARKET EGG PRODUCTION IN MAINE. A. E. Watson. The results of this study are based on information obtained from 115 pounltrymen for the year ending July 31, 1947. Date of hatching chicks did not materially influence egg production per bird but did affect egg size and the length of time required to reach large egg production. Of the total eggs sold, 81 per cent were large eggs, 15 per cent medium eggs, 3 per cent pullet eggs, and less than 1 per cent peewee eggs. The seasonal variation which occurred in egg prices indicated the advantage of high egg production during the summer and fall months. Handling methods at the farm, number and breed of laying birds kept, breed of chicks purchased, date chicks were obtained for flock replacement, as well as monthly egg sales by sizes, were studied.

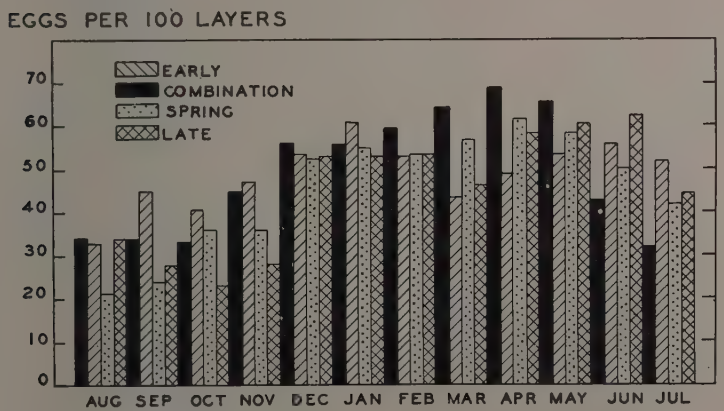

FIG. 5. Seasonal Variation in the Rate of Lay in Flocks with Different Hatching Dates.

MARKETING OF HATCHING EGGS. A. E. Watson, C. H. Merchant. This study was undertaken as part of the Northeast Regional Hatching Egg Project. Field work has been completed in Maine in which 171 hatching egg producers were interviewed. Information

was obtained relative to breeds kept, matings by seasons, disposition of eggs produced, market outlets, months of shipment, basis of payment, handling methods at the farm, as well as credit and transportation problems. Preliminary results indicate that during the period studied, over 40 per cent of the eggs produced by hatching egg flocks were sold as market eggs. The demand for eggs from straight run and sex-linked matings was heaviest during the period of December to May. Eggs from broiler cross matings were in heaviest demand from July to October. Trucks were used more extensively than other methods of transportation in shipping hatching eggs. More hatching eggs were shipped in cardboard cases than in other types of cases.

PRICES

AGRICULTURAL ADJUSTMENTS IN MAINE AND MAINE FARM PRICES IN POSTWAR PERIOD. C. H. Merchant. A manuscript is in preparation dealing with the major adjustments which have taken place in Maine agriculture over a long period of time and the more important adjustments which have taken place during and following World War II. As background material the United States census is used to show the general trends in acreage of crops grown and the number of various classes of livestock kept from 1880 to date. Recent information on crops and livestock, as well as other pertinent information on Maine agriculture, has been obtained from various published Government reports and from Production and Marketing Administration unpublished material in the State and county offices. The study also includes bringing up to date the information on farm prices and the general price situation during and following World War II. This information will supplement the material published in Bulletin 435, "Maine Farm Prices During World War Periods." State Committee reports on production adjustments for Maine covering the years 1946 and 1947 also were prepared in cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture in connection with production adjustment programs.

SHEEP

EARLY VERSUS LATE LAMBING. H. C. Dickey. The flock of 19 purebred Oxford ewes was divided into 2 lots. Nine ewes were flushed early in September 1947 and the ram was turned with them for breeding. Seven of these 9 ewes lambed during February, 1948. All 7 dropped twin lambs. However, 1 ewe dropped 2 dead lambs, another ewe had 1 dead lamb, and another ewe lost a lamb due to an accident. This meant that 7 ewes raised 10 lambs. These lambs gained ½ pound per head daily. The ewes and lambs were held in the lambing room at 65° to 70° F. until the lambs were about 10 days of age. They were then turned into the regular open shed and the lambs were fed grain in a creep. Phenothiazine has been used as a control for stomach worms and nodular worms by dosing in the fall and spring and mixing in the salt at the rate of 1 pound of phenothiazine to 9 pounds of salt. The results of this experiment will show whether it is profitable to lamb the ewes early in February, or to lamb in May for late lambing.

SOIL TESTING

SOIL TESTING LABORATORY. P. N. Carpenter. A total of about 10,000 samples of soil were analyzed during the past year for farmers and other individuals. These samples were tested for acidity (pH) and readily soluble calcium, phosphorus, potassium, and magnesium at a charge of 50 cents for each sample tested. The number of samples tested was about twice as large as the former high record of 5,161 samples for the previous year.

An additional number of soil samples have been analyzed in connection with research projects, including 600 samples for pH, 313 for organic matter, 194 for exchangeable calcium, 465 for exchangeable potassium, 388 for soluble phosphorus, and 126 for total nitrogen. Also 244 plant tissue samples were analyzed for total nitrogen and 6 for soluble potassium. Considerable work also was done on methods of analysis of soil and plant tissue. The acquisition of a flame photometer has been of great assistance in determinations for potassium, calcium and sodium.

STRAWBERRIES

STRAWBERRY VARIETY TRIALS. R. M. Bailey, C. W. Hitz, E. F. Murphy. Howard 17 (Premier) and Catskill are the most widely planted strawberry varieties in Maine. Both are highly susceptible to red stele disease which in recent years has seriously damaged many beds particularly those on heavy and poorly drained soils. In trials conducted at Highmoor Farm, Monmouth, *Sparkle* and *Temple* varieties were highly resistant to red stele, and compared favorably with Howard 17 in yield, plant and berry characters. *Pathfinder* has yielded well, producing bright, attractive, uniform berries of medium firmness. *Aberdeen* has equalled Howard 17 in yield but the fruit is pale, rather soft and mediocre in quality. Several unnamed seedling varieties obtained by crossing Aberdeen x Howard 17 are under study for red stele resistance and adaptability. In several years trials at Highmoor where red stele has not been a factor they have surpassed Howard 17 in yield and winter survival, and have compared favorably in berry characters.

The vitamin C content of these strawberry varieties was determined by E. F. Murphy. Seven samples of Howard 17 averaged 53 mg. per 100 grams. The Maine seedlings, many of which were crosses of Aberdeen x Howard 17, ranged from 37 to 59 mg. Tests of Aberdeen in previous seasons showed it to be below average in vitamin C content. Four New Jersey seedlings tested above average in 1947. The highest testing named varieties were Midland, Redstar, and Catskill, with 70, 67, and 63 mg., respectively.

TOMATOES

CONTROL OF LATE BLIGHT OF TOMATOES. M. T. Hilborn. A test of 9 fungicides on tomatoes showed that all could be applied without seriously reducing yields. Seasonal conditions did not permit late blight to become established on tomatoes in 1947. Consequently the efficiency of these fungicides in controlling this disease was not determined during the first year of this experiment.

TOMATO VARIETY TESTS. ***Yields.*** E. F. Murphy, Reiner Bonde, S. C. Junkins, J. H. Waring. Yields for the 20 varieties of tomatoes tested in 1947 at Orono and Presque Isle were affected by a cold wet spring in both localities and by an August drought in Orono.

Varieties differed significantly in yield on September 1st, 15th, and 18th. Orono yields were significantly higher than Presque Isle's only on September 18th. Differences by varieties on September 15th are shown in the following tabulation:

Variety	Lbs. per plant		Mg. ascorbic acid per 100 grams	
	Orono	Presque Isle	Orono	Presque Isle
Chatham	4.3	2.3	21.2	16.7
Abel	4.2	3.9	23.8	17.8
Red Cloud	3.7	2.0	17.6	13.1
Redskin	3.3	2.0	20.5	15.7
NDAC 38	3.3	2.6	23.9	14.4
Bison	3.2	3.5	17.6	13.3
F.N.C.	3.1	2.4	28.4	22.6
Nebraska 14-39	3.1	2.9	18.8	14.7
Bounty	2.6	2.2	16.2	12.9
N.H. Victor	2.4	1.7	21.2	17.4
Pritchard x Earliana	2.4	3.0	22.2	16.2
Denmark	2.2	2.2	18.0	15.0
Fordhook	2.0	2.8	19.8	16.2
Valiant	1.9	1.5	21.1	17.1
Early Trellis	1.6	2.2	27.7	21.4
Firesteel	1.5	2.6	18.7	14.0
Sioux	1.3	1.6	15.8	16.4
Bonny Best	1.1	1.7	15.7	13.0
Michigan 4502	1.1	2.9	20.6	15.6
Wisconsin 55	0.4	1.6	20.3	15.0
Least significant difference:				
5%	0.9	1.0	2.5	2.3
1%	1.2	1.3	3.3	3.0

Nutritive Value. E. F. Murphy. The vitamin C content differed significantly between the 20 varieties tested. These differences are shown in the tabulation above. Presque Isle tomatoes of the same varieties averaged 22 per cent lower in vitamin C value than in Orono. Observations over a period of years indicate low values are not characteristic of specific localities, but vary from year to year within an area due to fluctuating weather conditions.

When vitamin C values of 7 varieties of Orono-grown tomatoes for 4 years were plotted against the light intensity values (radiometer readings) for varying time intervals prior to harvesting, large discrepancies were apparent in some cases. However, when vitamin C values were compared with total light, average temperature, and total precipitation for a 3 weeks period, significant multiple correlation coefficients were obtained in 5 of the 7 varieties, with a 6th approaching significance. Vitamin C always varied directly with light, significantly so in 5 of the 7 varieties. The vitamin C values always varied inversely with temperature, significantly so in

2 of the 7 varieties. The magnitude of the influence of light was about 2.1 times greater than that of temperature. The beneficial effect of light evidently may be counteracted by a detrimental influence of high temperature. The effect of precipitation on vitamin C content was small and of no consequence.

The vitamin A content also was determined for 15 varieties of Orono-grown tomatoes. The resulting values ranged from 0.33 to 0.52 mg. per 100 grams of fresh tomatoes, but the differences were not significant.

Consumer Preferences. E. F. Murphy, M. R. Covell. High ranking varieties for flavor, of 21 early maturing varieties tested, were Early Trellis, Valiant, Firesteel, Abel, Bonny Best, Sioux, Wisconsin 55, and Pritchard x Earliana. Low ranking varieties were Redskin, Alaska, Chatham, Danmark, and Bison. In most cases, the consumer preferences were similar to those reported for 1946.

INSPECTION SERVICE

INSPECTION SERVICE. E. R. Tobey, C. H. White, B. E. Plummer, Jr., M. G. Moore, E. O. Merrill, J. S. Getchell, G. A. Waddell, Fay Hyland, and Joanne M. Goodine. The Commissioner of Agriculture is the executive of the laws regulating the sale of fertilizers, agricultural seeds, insecticides, fungicides, foods, drugs, and feeding stuffs in Maine. It is the duty of the Director of the Maine Agricultural Experiment Station to analyze or cause to be analyzed the samples collected by the Commissioner and to publish the results of the analyses together with the names of the persons from whom the samples were obtained and such additional information as may seem advisable. This information is reported in the Official Inspections published during the year. The State Tax Assessor is the executive of the laws regulating the sale of gasoline and motor lubricants. It is the duty of the Director of the Station to analyze or cause to be analyzed the samples collected by the State Tax Assessor but no provision has been made for the publication of the results of the analyses.

In addition to the inspection service the department is requested frequently to make analyses of various types of materials for individuals. The amount of this work, which the laboratory is able to

do, is limited by the amount of time that is available from the regulatory and research work. These unofficial samples include milk, cream, seeds, vinegar, miscellaneous substances, and materials suspected to contain poison. The results of the analyses on these samples are not published but are reported to the individuals who submit the samples.

A brief summary of the work of inspection is as follows:

Testing of Dairy Glassware. It is required by law that all Babcock glassware used in Maine by creameries, ice cream factories or others buying or selling milk or cream on a basis of the butterfat content, must be tested for accuracy at the Maine Agricultural Experiment Station. A total of 1790 pieces have been examined. Five pieces were not passed.

Fertilizer Inspection. A total of 197 samples of fertilizer materials were collected and analyzed. Of these samples, 155 were mixed fertilizers containing nitrogen, phosphoric acid, potash, and in some of the samples, magnesium. The samples of mixed fertilizers represented 120 different brands. Of the total number of samples received 42 were found to be below guaranty in total nitrogen, 48 in available phosphoric acid, 2 in total phosphoric acid, 22 in water soluble potash, 3 in total magnesium, and 2 in total calcium oxide. A comparison of the number of deficiencies with respect to the guaranties with the previous year shows no material change. The results of the analyses are reported in Official Inspections 205.

Agricultural Seeds Inspection; Fungicides and Insecticides Inspection. A total of 136 official samples of seeds and 116 official samples of fungicides and insecticides were collected and analyzed. Most of the seed samples showed satisfactory agreement between guaranties and results found in laboratory tests. The greatest differences in results of germination tests, as guaranteed and found, occurred in the legumes such as clover. In most cases the differences could be accounted for by changes in hard seed content. In most instances the hard seed content decreased in storage with a corresponding increase in laboratory germination. In a few cases the reverse occurred. As in previous years there were too many samples where the noxious weed content was not represented on the label.

An examination of the results of analyses of the official samples of fungicides and insecticides shows considerable improvement over

last year relative to the number of deficiencies in comparison to guaranties. This improvement is especially noticeable in samples containing DDT. Approximately 49 per cent of the total number of samples contained DDT. The results of the analyses are reported in Official Inspections 206.

Food and Drug Inspection. The number and variety of samples collected and submitted depend upon the nature of the inspection work carried on by the Division of Inspection, Augusta, Maine, in the enforcement of the food and drug laws. A total of 6032 samples which consisted of samples of enriched bread, dairy products (milk and cream), ice cream, oil used in packing sardines, shellfish, vinegar, lime water, spirit of peppermint, tincture of iodine, witch hazel, and miscellaneous samples, were examined and the results are reported in Official Inspections 207.

Two samples of white bread complied with the standards relative to thiamin and riboflavin but 2 samples of whole wheat bread, which is excluded from the law, were below the minimum standards established by law for the enrichment of white bread. All but 2 samples of oil used in packing sardines were soybean oil. One sample of olive oil and one sample of cottonseed oil were received. The results of the inspection showed that high grade oil is used in packing sardines in Maine. Among the shellfish samples 3 samples of oysters are reported which were soaked to a considerable degree with fresh water. Of the 5008 samples of milk and cream, 12 samples of raw milk were found to contain "added water." The number of milk samples meeting State standards in all categories increased 2.54 per cent while the number of cream samples decreased 1.25 per cent as compared to the previous year.

Feeding Stuffs Inspection. A total of 623 samples of feeding stuffs were received and the percentages of protein, fat, and fiber in these samples were determined. Thirty-two samples were found to be below guaranty in protein, 13 of which showed a deficiency of 5 per cent or more of the protein guaranty. Fifty-four samples were found to be below guaranty in fat and 117 samples exceeded the maximum guaranty in fiber. The results of the inspection, as shown by the number of deficiencies in comparison with the guaranties, indicate considerable improvement in the quality of the feeds sold in Maine during the past year. This improvement is especially noticeable in conformity to the protein and fiber guaranties.

Gasoline and Motor Lubricants Inspection. A total of 254 samples of gasoline were received. The results of the analyses indicated that all but 7 of these samples complied with the specification of the Maine law regulating the sale of motor gasoline, namely, that the maximum temperature for complete distillation shall not exceed 437° F. Six of the 61 samples of motor oils, which were examined, failed to meet the manufacturers' specifications for the respective brands asked for by the inspector.

WEATHER[21]

The weather was mild during January, February, and March 1947, with the temperature deviating 3.7° above the 29-year mean. June was characterized by heavy rain (5.16 inches which was 1.69 inches above the 34-year average) which delayed planting. July and August were favorable for crop development with well distributed nearly average rainfall during July, and 1.77 inches less than normal in August. The very dry October, with higher than normal temperatures (+6.3°) and practically no rainfall (.20 inch which was 3.92 less than normal) resulted in the tragedy of forest fires, which burned over large areas of woodland and several villages in Maine, with a loss of 15 lives and property damage estimated at thirty million dollars. The drought continued into the winter of 1948 causing the many hardships coincident with lack of water on farms and the rationing of hydro-electric power in Aroostook County. The annual mean temperature for 1947 was 45.7° F. (1.9° above the mean), and total rainfall was 37.61 inches (2.04 inches below the mean). Total snowfall was 59.0 inches. The growing season was 134 days from May 15 to September 26.

Weather records for Highmoor Farm, Monmouth, Maine, obtained by the Experiment Station Staff, were as follows:

[21] Information in the first paragraph was summarized by E. F. Murphy from data for Old Town, a few miles from Orono. Detailed figures for Old Town, Aroostook Farm in Presque Isle, and several other weather stations in Maine are available at the University of Maine Library in Climatological Data for the United States by Sections, U. S. Weather Bureau, Vol. 59, 1947. Weather records for Orono also are kept by the Department of Physics, University of Maine.

Month	Temperature			Total inches precipitation	No. of days with .01 inch or more precipitation
	Highest	Lowest	Average		
July 1947	88	52	71.5	3.86	14
August	97	47	70.2	.45	5
September	88	29	60.4	2.45	5
October	86	22	56.5	.36	4
November	65	11	35.2	4.79	6
December	48	0	27.7	1.33	7
January 1948	40	−14	16.8	2.60	12
February	51	−17	18.4	1.21	5
March	65	− 6	29.2	2.25	12
April	69	22	42.5	2.57	10
May	79	33	49.9	7.38	22
June	83	40	59.6	3.01	17

PUBLICATIONS

The results of the Experiment Station work are published in 3 separate series known as Experiment Station Bulletins, Miscellaneous Publications, and Official Inspections. These are printed reports with the exception of Miscellaneous Publications which sometimes are mimeographed. The Report of Progress is the final bulletin of the year and is bound in with the other bulletins to comprise the Annual Report.

One copy of each of these publications is available upon request to the Experiment Station at Orono, Maine, with the exception of mimeographed miscellaneous publications which are for restricted distribution by the author. Those who request having their names placed on the mailing list receive a card each year listing the new available bulletins. News items also are prepared concerning each bulletin when received from the print shop. A list of all currently available bulletins can be obtained upon request.

Research workers also make available the results of their projects through a number of other channels, including Extension Bulletins, articles in scientific journals and magazines, talks at meetings and radio programs, and news releases through press and radio.

A list of the various bulletins and scientific articles published during 1947-48 is given below. In addition, the Station Staff had about 20 articles published in magazines, presented about 20 papers at scientific meetings, gave approximately 30 radio talks, and spoke at about 115 meetings of farmers and others.

Experiment Station Bulletins:

No. 450. Grade Quality of Maine Potatoes. William E. Schrumpf. July, 1947. pp. 1-46.

No. 451. Costs of Distributing Milk in Maine Markets. Alvah L. Perry. July, 1947. pp. 47-105.

No. 452. Poultry Products Used by the Summer Trade in Maine. Andrew E. Watson. August, 1947. pp. 106-151.

No. 453. Labor Efficiency in Harvesting Hay. George F. Dow. August, 1947. pp. 152-222.

No. 454. Fertility Status of Potato Soils of Aroostook County, Maine, and Relation to Fertilizer and Rotation Practices. Arthur Hawkins, Joseph A. Chucka, and A. J. MacKenzie. July, 1947. pp. 223-266.

No. 455. Concerning Pressure Saucepans. Merna M. Monroe. September, 1947. pp. 267-282.

No. 456. Costs and Returns in Milk Production for Local Maine Markets. Alvah L. Perry and George F. Dow. October, 1947. pp. 283-324.

No. 457. Recent Advances in Spray Practices for Maine Apple Orchards. F. H. Lathrop and M. T. Hilborn. January, 1948. pp. 325-353.

No. 458. Two Homemade Spray Booms for Maine Apple Orchards. M. T. Hilborn, F. H. Lathrop, F. J. McDonald, C. Crocker, and D. Tripp. February, 1948. pp. 354-369.

No. 459. Factors Affecting Seasonal Milk Production and Their Effect on Producers' Costs and Returns. A Cooperative project of the Northeast and North Central Experiment Stations and the Bur. Agr. Econ., U. S. Dept. Agr. April, 1948. pp. 1-46.

No. 460. Science Serves Maine Agriculture, Sixty-fourth Annual Report of Progress, Year Ending June 30, 1948. June, 1948. pp. 1-75.

Official Inspections:

No. 204. Commercial Feeding Stuffs, 1946-47. Elmer R. Tobey. July, 1947. pp. 1-30.

No. 205. Commercial Fertilizers, 1947. Elmer R. Tobey. October, 1947. pp. 31-58.

No. 206. Commercial Agricultural Seeds, 1947, F. Hyland; Fungicides and Insecticides, 1947, Elmer R. Tobey. December, 1947. pp. 59-94.

No. 207. Foods and Drugs. Elmer R. Tobey. June, 1948. pp. 95-129.

Miscellaneous Publications of Experiment Station:

No. 606. Improving Haying Efficiency Thru Changes in Work Methods, a Case Study of Buckrake Operations. Irving F. Fellows, Bur. Agr. Econ., U. S. Dept. Agr. July, 1947. 9 pages, mimeographed.

No. 607. The Effect of Weather upon the Rate of Air Seasoning of Wood Products in Maine. Gregory Baker. January, 1947. 5 pages. mimeographed.

No. 608. Field Corn Variety Recommendations for Maine and Report of 1947 Trials at Highmoor Farm, Monmouth, Maine. R. M. Bailey. March, 1948. 5 pages, mimeographed.

No. 609. 1947 Sweet Corn Trials at Highmoor Farm, Monmouth. R. M. Bailey. March, 1948. 11 pages, mimeographed.

No. 610. List of Available Publications. April, 1948.

No. 611. 1947 Stringless Bean Trials, Highmoor Farm, Monmouth, Maine. A. A. Virta, Lyle Littlefield and R. M. Bailey. April, 1948. 3 pages, mimeographed.

——. A Recommended Basis of Pricing Class I Milk in the Boston Market. Boston Milkshed Price Committee, George F. Dow, Chairman. September, 1947. Technical report 108 pages and condensed report 21 pages, published by Boston Milk Market Administrator.

——. Chemical Treatment and Seasoning of Thick Beech Stock. Edward C. Peck, Gregory Baker, and Roy M. Carter. April, 1948. 7 page mimeographed report No. R1708, U. S. Dept. Agr., Forest Service, Forest Products Laboratory, Madison, Wisconsin.

Extension Bulletins Prepared by Station Author or Coauthor:

No. 353. Apple Spray and Dust Recommendations for Maine. Frank Lathrop, M. T. Hilborn, C. W. Hitz, and O. L. Wyman. March, 1947. 16 pages.

No. 355. Hardy Stocks in the Apple Orchard. J. H. Waring and M. T. Hilborn. May, 1947. 15 pages.

No. 356. Budding and Grafting Apple Trees. J. H. Waring and M. T. Hilborn. May, 1947. 16 pages.

No. 358. Spraying and Dusting Pears, Peaches, Plums, and Cherries. M. T. Hilborn, Frank H. Lathrop and Chester W. Hitz. April, 1947. 10 pages.

No. 373. Efficient Fertilization of Potatoes in Maine. Arthur Hawkins, Gilbert L. Terman and Oscar L. Wyman. March, 1948. 16 pages.

No. 381. Fertility Management in Maine Orchards. Moody F. Trevett and Chester W. Hitz. May, 1948. 20 pages.

Cir. 237. Maine Children Can Be Healthy Like This Boy. Dr. Mary M. Clayton. September, 1947.

Cir. 247. The European Corn Borer and its Control. John H. Hawkins and Joseph C. Hickey. April, 1948.

Articles in Scientific Journals:

Bonde, Reiner, F. J. Stevenson, and Robert V. Akeley. Breeding Potatoes for Resistance to Ring Rot. Phytopathology 37:539-555. August, 1947.

Clayton, Mary M., E. Frances Pressey, and Katherine H. Lees. Vitamin C Content of Home-Canned Tomatoes as Determined by Variety and Method of Processing. 1948. Food Research, 13:36-43.

Folsom, Donald. Inheritance of Predisposition of Potato Varieties to Internal Mahogany Browning of the Tubers. Amer. Potato Jour. 24:294-298. September, 1947.

Folsom, Donald. Permanence of Greening of Potato Tubers. Amer. Potato Jour. 24:336-340. October, 1947.

Folsom, Donald, J. S. Getchell, and Reiner Bonde. Bacterial Red Xylem Disease of Potato Tubers in Maine. Plant Disease Reporter 32(6): 230;231. June, 1948.

Harris, M. R. Accuracy of the Ultraviolet Light Method in Selecting Potato Tubers Free of Virus. Amer. Potato Jour. 24:179-183. 1947.

Harris, M. R. A Phycomycete Parasitic on Aphids. Phytopathology 38: 118-122. 1948.

Hovey, Charles, and Reiner Bonde. Physalis Angulata L. a Test Plant for the Potato Leaf Roll Virus. (Abst.) Amer. Potato Jour. 25:52. 1948.

Peck, Edward C., Gregory Baker, and Roy M. Carter. Chemical Treatment and Seasoning of Thick Beech Stock. Timber of Canada, vol. 8, No. 10: 34, 75-76. June, 1948.

Peck, Edward C., Gregory Baker, and Roy M. Carter. Turning Beech to Bowl Stock with Chemicals. Wood, vol. 3, No. 6:22-23. June, 1948.

Shands, W. A., and G. W. Simpson. The Production of Alate Forms of Myzus Persicae on Brassica Campestris in the Greenhouse. Jour. Agr. Research 76 (7, 8):165-173. April, 1948.

Snieszko, S. F., J. B. Carpenter, E. P. Lowe, and J. G. Jakob. Improved Methods for the Cultivation and Storage of Phytophthora Infestans. Phytopathology 37:635-649. 1947.

FINANCIAL REPORT

The total income of the Station received during the year ending June 30, 1948 was $461,191.45. Of this amount, 32.5 per cent was from Federal funds, 21.5 per cent from the State Mill Tax, 14.1 per cent from industry taxes on blueberries and potatoes, 13.5 per cent for inspection analysis and the Florida potato test, 12.6 per cent from the sale of farm products, 2.1 per cent for potato storage, and 3.7 per cent from special research grants.

The increase in income over that of the previous year was $95,020.81. This included an increase of $37,464.50 in Federal-Grant funds from the Research and Marketing Act of 1946, which was used for additional research in marketing, rural housing, and human nutrition. An additional $9,616.40 was received for the new experimental potato storage at Aroostook Farm. Also the support from Potato Tax funds was increased substantially. The increased income provided for new research and for increased costs for

personal service, supplies, equipment, and travel involved in the research program.

A summary of the income and expenses for the year 1947-48 is given below. More details of expenditures of Federal and State funds are given on the following page.

Summary of Income and Expenditures of The Maine Agricultural Experiment Station July 1, 1947 to June 30, 1948

Source of funds	Income	Per cent of income	Expenditures
Hatch Act	$ 15,000.00	3.25	$ 15,000.00
Adams Act	15,000.00	3.25	15,000.00
Purnell Act	60,000.00	13.01	60,000.00
Bankhead-Jones Act	22,408.10	4.86	22,408.10
1946 Research and Marketing Act	37,464.50	8.13	37,464.50
Total Federal funds	$149,872.60	32.50	$149,872.60
State Mill Tax	$ 99,021.16	21.47	$ 89,564.64[1]
Potato Tax	49,131.72	10.65	49,131.72
Blueberry Tax	15,813.41	3.43	13,682.01
Inspection Analysis	26,302.62	5.70	26,302.62
Potato storage	9,616.40	2.09	10,267.86
Florida potato test	36,141.00	7.84	33,757.05
Sales and service	58,360.44	12.65	53,556.87
Special research grants[2]	16,932.10	3.67	11,702.54
Total	$461,191.45	100.00	$437,837.91

[1] The balance of $9,456.52 from the State Mill Tax is included in the $53,556.87 for Sales and Services in connection with the experimental farms.

[2] Special research grants were received from:
Maine Sea and Shore Fisheries, for lobster study
Maine Department of Agriculture, for corn borer research
Summers Fertilizer Company, for fertilizer research and land clearance
Kraft Foods Company, for Irish moss investigations
C. M. Cox Company, for poultry studies
Eastern States Farmers' Exchange, for work on economic production of efficient size seed potatoes
General Chemical Company, for fungicide tests
Maine Canners' Association, for corn breeding research
Maine Potato Growers, Inc., for tests with helicopter dusting
Shell Oil Company, for testing insecticides

Classification of Expenditures of Federal and State Funds by the Maine Agricultural Experiment Station, July 1, 1947 to June 30, 1948

Source of funds	Personal services	Supplies, materials	Travel	Equipment	Repairs, alterations	Printing, binding	Utilities, rent	Transportation, communication	Land, buildings
Hatch Act	$ 11,147.98	$ 780.83	$ 777.97	$ 341.00	$ 42.69	$ 884.09	$ 386.03	$ 639.41	$ —
Adams Act	14,176.85	643.16	68.35	103.32	8.32	—	—	—	—
Purnell Act	44,049.45	9,696.84	1,570.37	1,299.87	1,400.73	931.95	1,000.00	50.79	—
Bankhead-Jones Act	18,497.04	701.31	937.62	146.82	825.41	1,128.32	152.98	18.60	—
1946 Research and Marketing Act	22,535.85	1,221.40	7,785.44	3,591.97	1,849.39	50.00	217.70	212.75	—
All Federal funds	$110,407.17	$13,043.54	$11,139.75	$ 5,482.98	$ 4,126.54	$2,994.36	$1,756.71	$ 921.55	—
State Mill Tax	$ 59,869.53	$ 9,174.91	$ 5,509.08	$ 4,949.92	$ 2,691.24	$3,239.77	$2,616.56	$1,513.63	$ —
Potato Tax	33,554.55	6,176.47	3,148.68	3,526.73	1,772.23	173.00	503.76	276.30	—
Blueberry Tax	5,707.58	2,153.98	801.67	1,910.77	1,005.88	—	461.25	105.15	1,535.73
Inspection Analysis	23,042.65	1,420.85	296.17	469.66	136.31	19.96	487.38	429.64	—
Potato Storage	—	—	—	—	—	—	—	—	10,267.86